THE
Normal Diet

By

W. D. SANSUM, M.S., M.D.

SECOND EDITION

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A Simple Statement of the Fundamental Principles of Diet for the Mutual Use of Physicians and Patients

BY

W. D. SANSUM, M.S., M.D., F.A.C.P.

DIRECTOR OF THE POTTER METABOLIC CLINIC, DEPARTMENT OF METABOLISM, SANTA BARBARA COTTAGE HOSPITAL, SANTA BARBARA, CALIFORNIA

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DEDICATED

to

An Effort to Prevent Illness,
Relieve Suffering, and Prolong Life
Through the Proper Use
of Food

PREFACE TO SECOND EDITION

For many years I have given the subject matter of this book in lecture form to patients suffering from the various nutritional disorders.

Diet errors are very common, and such errors are undoubtedly responsible for many minor ailments as well as some of the more serious ones. I therefore believe that a simple statement of the fundamental principles underlying the selection of a normal diet may fill a definite need.

Regardless of their relative importance, I seem to accomplish the greatest good for the greatest number of people by discussing these principles in the order adopted in this edition. In addition to the normal diet menus, and to meet what I consider a just demand for more concrete information, I have also included special menus to illustrate how such diets may be built without violating any of the fundamental principles.

I wish to especially thank Miss Ruth Bowden, B.S., for her assistance in preparing the diet menus and my secretary, Miss Ruth Braden, for her assistance in the preparation of this manuscript.

W. D. Sansum.

Santa Barbara College Hospital,
Santa Barbara, California.

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INTRODUCTION

In the selection of the normal (most favorable) diet, there are eight known fundamental principles which should be considered.

1. The normal diet should contain an adequate amount of the bulky, residue-containing foods to insure natural movements of the bowels.

2. The normal diet should contain an adequate amount of the alkaline-ash foods to balance the acid-ash foods.

3. The normal diet should contain an adequate amount of the starches and sugars to prevent the acetone type of acidosis.

4. The normal diet should contain an adequate number of food units, or calories, to maintain the individual under usual activities at a normal weight for the age, sex and height. Overweight, as well as underweight, should be avoided.

5. The normal diet should contain an adequate amount of protein.

6. The normal diet should include an adequate amount of the mineral-containing foods.

7. The normal diet should contain an adequate amount of the vitamines.

8. The normal diet should contain an adequate amount of fluids.

THE NORMAL DIET

CHAPTER I

NORMAL DIET MENUS

Most individuals are more interested in the practical diet menus than in their theoretical construction. Excellent results are so often obtained when such diet menus are faithfully followed, that further instruction is sometimes unnecessary. I have used the diet menus which follow for many years both in hospital work and in private practice. These diets may be simplified for home use if desired by using larger servings of one of the bulkier vegetables rather than two small servings of different vegetables. The dinner may be served in the evening and the supper may be served as lunch. Unless a very accurate check of the calories is desired, any breakfast, dinner or supper may be eaten on any day. Ten daily menus are presented because some foods are out of season during certain periods of the year. As the principles outlined in the remaining chapters are fully appreciated, substitutions may be made.

1

Breakfast

Melon
Shredded Wheat with Milk and Sugar
Scrambled Eggs
Toast and Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Tomato Bisque
Roast Chicken with Dressing Mashed Potato and Gravy
Baked Squash Buttered Celery
Pineapple and Marshmallow Salad with Whipped Cream Dressing
Bread and Butter
Chocolate Sundae Cake
Tea with Cream and Sugar

Supper

Creamed Macaroni
Spinach on Toast with Poached Egg
Baked Tomato
Bread and Butter
Assorted Fresh Fruits
Milk

Approximate composition and caloric value: Carbohydrate 300 grams, protein 80 grams, fat 100 grams, bulk 800 grams, calories 2420.

2

Breakfast

Orange Sections
Oatmeal with Milk and Sugar
Melba Toast Butter
Bacon
Coffee with Cream and Sugar
Grapefruit Juice with Lemon

Dinner

Vegetable Soup
Breaded Veal Chop Scalloped Potatoes
Creamed Cauliflower Small Peas
Tomato Salad with French Dressing
Bread and Butter
Apple Betty with Hard Sauce
Tea with Cream and Sugar

Supper

Liver and Bacon
Baked Potato Buttered Asparagus
Bread and Butter
Baked Apple
Milk

Approximate composition and caloric value: Carbohydrate 290 grams, protein 90 grams, fat 90 grams, bulk 900 grams, calories 2330.

3

Breakfast

Banana
Corn Flakes with Milk and Sugar
Coddled Egg
Toast and Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Cream of Celery Soup
Roast Beef Browned Potatoes
Buttered Carrots Stewed Tomatoes
Waldorf Salad
Bread and Butter
Cottage Pudding with Strawberry Sauce
Tea with Sugar

Supper

Creamed Chicken on Toast Points
Baked Sweet Potato Baby Lima Beans
Bread and Butter
Fresh Pineapple
Milk

Approximate composition and caloric value: Carbohydrate 285 grams, protein 90 grams, fat 90 grams, bulk 800 grams, calories 2310.

4

Breakfast

Apple Sauce
Cream of Wheat with Milk and Sugar
Bacon
Toast and Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Melon
Sirloin Steak Hashed Browned Potatoes
String Beans Egg Plant
Pear and Cottage Cheese Salad with French Dressing
Bread and Butter
Fruit Jello
Tea with Cream and Sugar

Supper

Stuffed Potato
Scalloped Cabbage with Cheese
Egg Ring Salad with Boiled Dressing
Bread and Butter
Hermits Fresh Sliced Peaches
Milk

Approximate composition and caloric value: Carbohydrate 305 grams, protein 90 grams, fat 102 grams, bulk 900 grams, calories 2498.

5

Breakfast

Sliced Peaches
Wheatena with Milk and Sugar
Omelet with Currant Jelly
Wheat Muffins and Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Vegetable Soup
Roast Lamb and Mint Sauce Mashed Potatoes
Buttered Onions Small Peas
Orange and Grape Salad with French Dressing
Bread and Butter
Ginger Bread with Whipped Cream
Tea with Sugar

Supper

Braised Sweetbreads with Mushroom Sauce
Creamed Potato Buttered Italian Squash
Bread and Butter
Red Raspberries Sugar Cookies
Milk

Approximate composition and caloric value: Carbohydrate 315 grams, protein 90 grams, fat 105 grams, bulk 800 grams, calories 2565.

6

Breakfast

Stewed Prunes
Puffed Rice with Milk and Sugar
Poached Egg on Toast
Melba Toast Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Cream of Corn Soup
Baked Halibut
Parsley Potato Sliced Tomato
Lettuce Salad with French Dressing
Fruit Sherbert Wafers
Tea with Cream and Sugar

Supper

Cheese Souffle
Baked Potato Fresh Spinach
Combination Vegetable Salad with Boiled Dressing
Bread and Butter
Fresh Strawberries
Milk

Approximate composition and caloric value: Carbohydrate 270 grams, protein 80 grams, fat 90 grams, bulk 800 grams, calories 2210.

7

Breakfast

Melon
Pettijohns with Milk and Sugar
Bacon
Toast and Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Split Pea Soup
Lamb Stew with Vegetables
Boiled Potato
Stuffed Prune Salad with Cottage Cheese and Whipped Cream
Bread Pudding with Fruit Sauce
Tea with Sugar

Supper

Baked Beans
Spanish Pickles Fresh Spinach
Orange and Grape Salad with French Dressing
Corn Bread Butter
Baked Apple
Milk

Approximate composition and caloric value: Carbohydrate 290 grams, protein 75 grams, fat 85 grams, bulk 900 grams, calories 2225.

8

Breakfast

Grapefruit
Shredded Wheat with Milk and Sugar
Scrambled Egg
Toast and Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Fresh Fruit Cocktail
Chicken Broth with Rice
Broiled Chicken Mashed Potatoes and Gravy
Buttered Asparagus Celery Hearts
Small Peas Olives
Pineapple Sundae and Cake
Coffee with Sugar

Supper

Boiled Rice
String Beans Baked Tomato
Tuna Salad
Hot Biscuits and Butter
Apricot Whip
Milk

Approximate composition and caloric value: Carbohydrate 270 grams, protein 80 grams, fat 90 grams, bulk 800 grams, calories 2200.

9

Breakfast

Rhubarb
Cream of Wheat with Milk and Sugar
Liver and Bacon
Toast Butter
Coffee with Cream and Sugar
Orange Juice

Dinner

Vegetable Soup
Roast Beef Potato Cake
Buttered Celery Cold Slaw Creamed Carrots
Bread and Butter
Stuffed Baked Apple
Tea with Cream and Sugar

Supper

Jelly Omelet
Buttered Peas Braised Lettuce
Pineapple and Cottage Cheese Salad with French Dressing
Bread and Butter
Peach Compote
Milk

Approximate composition and caloric value: Carbohydrate 310 grams, protein 95 grams, fat 100 grams, bulk 900 grams, calories 2520.

10

Breakfast

Orange
Shredded Wheat with Milk and Sugar
Broiled Ham
Toast with Butter and Jelly
Grapefruit Juice with Lemon
Coffee with Cream and Sugar

Dinner

Cream of Celery Soup
Swiss Steak Baked Sweet Potato
Sliced Tomato
Pear and American Cheese Salad with French Dressing
Bread and Butter
Tapioca Cream
Tea with Sugar

Supper

Chicken Souffle with Mushroom Sauce
Baked Potato Egg Plant
Asparagus Salad with French Dressing
Bread and Butter
Sponge Cake
Milk

Approximate composition and caloric value: Carbohydrate 290 grams, protein 100 grams, fat 110 grams, bulk 800 grams, calories 2550.

CHAPTER II

THE BULK REQUIREMENTS OF THE BODY

The normal diet should contain an adequate amount of the bulky, residue-containing foods to insure natural movements of the bowels.

There is a growing tendency, probably more marked in the United States than in any other country, to live upon the concentrated foods, such as the fine, white, patent flours, the meats, eggs, milk, sugars and fats, and to use an inadequate amount of the bulky, residue-containing foods, such as the fruits and vegetables. This is true, especially in the large cities, where the old-fashioned garden is an impossibility, and where fresh fruits and vegetables are very expensive because of their perishable nature, the cost of their transportation, and their low nutritive value. Whole wheat flour spoils easily, whereas fine, white flour may be kept for long periods of time. I believe that fully one-half of the sickness that has come under my observation has been due, either directly or indirectly, to the elimination of the bulky foods from the diet.

It will be helpful to review here some essential facts of anatomy and physiology. Fig. 1 represents, diagrammatically, the esophagus or gullet, the stomach, the small intestine, the colon and the rectum, which together are spoken of as the alimentary tract.

Food, taken by mouth, passes down the esophagus into the stomach. The stomach is normally situated just beneath the diaphragm. In adults, it usually holds approximately three pints, but soon accommodates itself to any change in the amount of food taken, so that it may

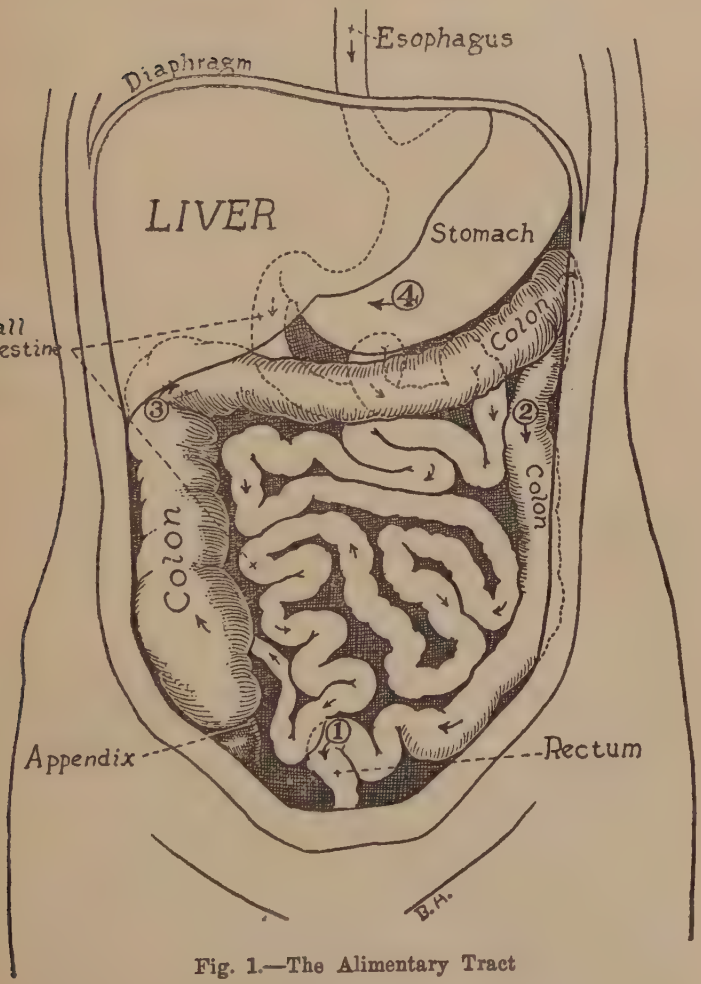

Fig. 1.—The Alimentary Tract

hold only one pint or many pints. The digestive processes commence in the stomach, but very little food is absorbed from it.

From the stomach, the food passes into the small intestine, which is a tube averaging about twenty-seven feet in length. In it, the digestive processes are practically completed, and from it, nearly all of the calorie-containing foods are absorbed.

From the small intestine, the unabsorbed residue, in a liquid state, passes into the colon or large bowel. The colon is a large tube, nearly two inches in diameter and averaging about five and one-half feet in length. Normally, it is about as thick as the wrist. As shown in Fig. 1, it passes up the right side of the body, across beneath the stomach, up to the left of the stomach, down the left side of the body and across to the center, where it terminates in the rectum. A knowledge of the location of the colon, in relation to the other abdominal organs, is important because colon disturbances are so often wrongly diagnosed.

During the day and night the indigestible residue, less most of its water, accumulates in the lower portion of the colon, known as the sigmoid flexure. The rectum is a much smaller tube about five inches in length closed at the lower end by the small but strong, sphincter muscles of the anal canal. The bowel turns so sharply above the rectum that it acts functionally as a valve holding the fecal material from passing into the rectum during the day. Usually, in the morning, as one moves around, and provided there is ample residue in the colon, the fecal matter is pushed into the rectum which should cause the natural urge for a bowel movement. The contents of the alimentary tract are forced along by peristaltic waves, such as the reader

may have seen in freshly killed animals, each wave consisting of an advancing constriction or progressive squeeze. Under normal conditions, the bowel movement for the following day accumulates in the lower part of the large bowel, but not in the rectum, as many people believe, *1*, Fig. 1. The residue for the bowel movements of the next two days is found in the colon, *2* and *3*. The food taken on any particular day furnishes the residue for the movement of the fourth day. On a diet largely residue-containing, the time may be shortened to forty-eight hours, but on a low residue diet it is often extended to four or five days. Although this lapse of time, which occurs between the taking of residue into the stomach and its elimination from the rectum, is usually not appreciated, it is a phenomenon which may be easily demonstrated. If a few charcoal tablets are taken following a meal, the charcoal will provide a black marker in the otherwise yellow or brown stool. None of it will be found in the normal stool of the same or the next day. A trace may be found in the normal stool of the third day, but the greater part will be found in the normal stool of the fourth day, that is, after a lapse of seventy-two hours from its ingestion. Some may be found even in the normal stool of the fifth day.

Alvarez and Freedlander[1] conclude from a long series of experiments, in which they used small, glass beads to test the rate of progress of food residue through the bowel, that the commonly accepted view that food residues from any one meal will be evacuated in the next twenty-four or forty-eight hours, is largely erroneous, and that it takes until the fourth day before 80 per cent of the beads are eliminated. Burnett[2] concludes from a similar study, in which he used French millet

seeds for a marker, that the normal emptying time varies from sixty-three to one hundred thirty-four hours. He was especially interested in the relation of bowel absorption and skin diseases. Rates from fourteen to sixty-two hours were associated with malabsorption, whereas when the rate was slowed to sixty-three to one hundred thirty-four hours, the skin became healthy, and remained so as long as it received this kind of nutrition.

There is nothing mysterious about the content of the bowel movement. It is made up largely of the indigestible food residues, the major portion of which is cellulose, the cell walls of plants. It is true that a small percentage of the stool is composed of the dead and living bodies of bacteria which live and multiply in the colon and rectum, and that another small percentage is composed of secretions, especially bile, into the alimentary tract, but these constituents are so comparatively small that they may be ignored here.

Let us therefore consider foods from the standpoint of their indigestible residues:

1. The grains or cereals, as wheat, oats, rye, corn, rice, etc., prepared as they are today as breakfast cereals, and fine, white flours for bread and pastry, have had most of the indigestible residues removed as bran and shorts. They are almost completely digested and absorbed.

2. Meats, including fowl, fish and shell-fish, are almost completely digested and absorbed. Dogs fed wholly on meat may have but one bowel movement in five days, and this is no larger than if they had been starved. It is a small, black stool, and consists chiefly of bacteria and secretions into the alimentary tract. Flesh-eating animals usually eat the bones with the

meat and thus obtain ample residue. Steffanson found the Eskimos eating the heads of fish with the soft bones and kept himself healthy by following their example.

3. Eggs are almost completely digested and absorbed.

4. Milk and milk products, such as cheese, butter and buttermilk, are almost completely digested and absorbed. Patients on a milk diet, where many quarts of milk are consumed each day, may have bowel movements, but the stool examinations show such movements are due to undigested milk protein and fat.

5. Sugars leave no residue.

6. Fats and oils of animal and vegetable origin are almost completely digested and absorbed unless used excessively.

These six groups of foods, together with the combinations made from them, comprise the diet upon which most people like to live today. The result is inevitable. Such persons may not, and usually do not, have natural movements of the bowels because the colon and rectum do not fill sufficiently. They therefore resort to the use of cathartics.

A drastic cathartic empties the whole intestinal tract, causing one or more watery stools. The patient is satisfied with the result. The next day he usually has no stool but is not alarmed because he has had such a "good" movement the day before. The following day he may still have no stool, and one may not be expected, because, even if he is taking a diet containing a large amount of residue, the colon has not yet had time to fill. But he has been taught that a daily movement of the bowels is necessary for health, and on the evening of the second day, he usually takes another cathartic. Thus the habit is formed. Many persons take some

form of cathartic daily, or every other day, thus never permitting the bowels to fill and act naturally.

Five agencies for artificially emptying the bowels are now in general use, namely: (1) the concentrated vegetable and mineral irritants, either singly or in combination, in pill or liquid form, as cascara, rhubarb, calomel, senna, aloin, podophyllum, jalap, phenolphthalein, herb teas, and castor and croton oils, (2) the salts and saline cathartic waters, (3) the mineral oils, either alone or in combination with agar-agar, (4) the enemas, and (5) the drinking of excessive amounts of water or salt water on an empty stomach before breakfast.

(1) The concentrated vegetable and mineral irritants act upon the inner lining of the stomach and bowel in the same manner as an irritating substance affects the eye which "waters" when such a substance comes in contact with the conjunctiva. The mucous membrane of the eye exudes water in order to eliminate the offending irritant. In a similar manner, the mucous membrane of the bowels "waters" under the influence of the cathartic irritants, and it is the "tears" on a large scale which produce the copious, unnatural, watery bowel movements. The old compound cathartic pills were colored black or brown, but now they are colored pink, perhaps to make them appear innocent, but they contain the same irritating substances on the inside.

(2) The salts and the various saline cathartic waters act on a different principle. Each particle of salt has a marked affinity for water, so that, when a concentrated solution of many millions of salt particles enters the alimentary tract, large quantities of water are drawn into the lumen of the bowels and copious movements result. The inexpensive dry salts of our grandmothers' day are now largely replaced by cathartic waters. Some

of these waters come from natural springs that contain cathartic substances, but to most of them additional amounts of the various well-known cathartic salts are added to make the natural waters more effective.

(3) Mineral oils, unlike animal and vegetable oils, are indigestible. One ounce of mineral oil will eventually produce one ounce of stool. These oils are certainly less harmful than pills or salts, but when taken in sufficient quantities they unnaturally hasten the emptying time of the bowel and oftentimes disagreeably leak from the rectum soiling the clothing or the bed. Agar-agar, a cellulose prepared from seaweed, is now mixed with mineral oil forming a stable emulsion, which, in addition to giving extra bulk, also prevents the disagreeable leaking. Mineral oil alone, or in combination with agar-agar produces an effective bulk and in themselves, aside from unduly accelerating the emptying time of the bowel, may do no harm, but they are unnatural substitutions for fruits and vegetables, which, in addition to furnishing ample natural bulk, have other properties of far greater importance.

(4) The normal or physiological salt enema, prepared by the addition of a level teaspoonful of common table salt to the pint of warm water, is nonirritating. The soap-suds enema is especially irritating, as will be appreciated when it is recalled how irritating soap-suds are to the mucous membrane of the eye. Even a plain water enema is irritating because it produces a swelling and often destruction of the cells lining the colon. Enemas containing glycerin, salts or molasses act upon the same principle as the concentrated salts taken by mouth.

(5) Many individuals drink excessive amounts of water, two and three pints, on an empty stomach before

breakfast. This is more fluid than the stomach and bowel can rapidly absorb and hence some of it reaches the colon, unnaturally pushing along the food residues which should remain in the colon sufficiently long to permit of the absorption of the valuable mineral foods. It is true that many individuals do not drink enough fluid during the day, and I have no objection to the drinking of a reasonable amount of water in the morning, but large amounts of fluid should not be taken on an empty stomach for the purpose of stimulating bowel action.

The cathartic or enema habit eventually leads to a degree of damage to the colon, sufficient to cause abdominal pain. There are no pain nerves on the inner lining of the colon or small bowel. Hence considerable damage may be done before distressing, abdominal pain alarms the patient. This pain may be localized in the region of the cecum, the beginning of the colon, when the cause is frequently and erroneously diagnosed as chronic appendicitis. Undoubtedly, many appendices were removed before it was realized that the distress of appendicitis could be so similar to that of chronic colitis.

If the pain is located in the region of the liver, it is oftentimes wrongly attributed to liver trouble. It is true that patients who continually take cathartics, do frequently have "bilious" attacks. Patients who are constipated from a lack of sufficient fruits and vegetables in the diet oftentimes have very sour stomachs as will be explained later. The excessively acid condition of the stomach stimulates the flow of an excessive amount of bile. When the colon has been irritated to a sufficient degree, it becomes spastic, a condition in which it has a contracted, rope-like feeling.

The lumen becomes constricted and waste material is prevented from passing through it readily. Under such circumstances, reverse peristalsis often occurs and bile is forced back into the stomach, thus resulting in the so-called "biliousness." A drastic cathartic forcibly evacuates the bowels, thus eliminating the bile, but at the same time it aggravates the bowel condition, the "biliousness" soon recurs and the patient takes another cathartic. Practically all of the so-called liver pills, which are so widely advertised in the lay press, are nothing more than cathartic substances.

If the pain is located in the region of the stomach—and it will be noted from the diagram (Fig. 1) that the transverse colon is attached to the lower edge of the stomach—then the patient believes he has stomach trouble.

If gas accumulates in the loop of the colon to the left of the stomach, the patient frequently complains of heart pains. Such pains are probably due to the gas which, since it is not readily eliminated by a spastic, contracted bowel, presses upward against the diaphragm, which in turn presses against the heart.

If the pain is in the region of the kidney, it is sometimes attributed to kidney trouble, although, with the exception of stones, tumors and infections of the kidney, the great majority of the kidney derangements are painless.

If the pain is lower down in the abdomen and the patient is a woman, it is often wrongly diagnosed as "female trouble."

At the lower end of the rectum, the continual passing of irritating substances produces hemorrhoids, or piles and extremely painful fissures and fistulas. Piles that protrude and are pinched by the constricting anal ring

are excruciatingly painful. I recall a very striking illustration of painful hemorrhoids caused by harsh purging. The patient was in the habit of going to New York periodically to have a "good time" which consisted of eating rich, concentrated, non-residue foods and drinking large quantities of whiskey. Following such a debauch, and in order to eliminate the "poisons" from his system, he would "repent" by resorting to large doses of castor oil, followed by large doses of salts. In this particular instance, after he had had his "good time" and had "repented" in the usual way, several very large hemorrhoids protruded and were pinched by the spastic, contracted anal ring. The pain was so intense that morphine gave no relief, and when seen he was contemplating suicide. Large, hot packs, applied to the rectum soon relieved the spasm. The hemorrhoids shrank and it was possible to push them up into the rectum. The first step in the treatment of hemorrhoids is a discontinuance of the use of all cathartics. White vaseline should be used freely after bowel movements when most hemorrhoids will soon cease to be troublesome.

From these varied pains and distresses, it will be readily understood why the lack of sufficient bulk in the diet, together with a lack of knowledge of the anatomy and physiology of the bowels and the misuse of cathartics, cause so many patients to seek the physician.

The normal diet should include sufficient residue-containing foods to insure natural movements of the bowels. The residue foods are the fruits and vegetables. To these might be added bran, but bran should never be used in greater concentration than is found in the whole grains, lest it produce a condition of irritation similar

to that caused by cathartics. Bran is in addition a very acid food as will be explained later. The average, constipated person requires approximately two pounds of the residue-containing foods daily to insure natural bowel movements. Patients under hospital care are served a weighed amount of fruits, vegetables and whole grain products. Our dietitians inspect the trays when returned and report the total amount of bulky food actually eaten. I have my office patients buy postal scales, weigh and record the bulky foods eaten with the amounts and bring in a report at the end of a week. Two pounds of such foods may seem a large quantity, as it is usually several times as much as most people eat, but it will be recalled that our bodies were designed a long time ago when the race was living upon large quantities of the coarse foods. In time, the alimentary tract might adapt itself to the modern concentrated diets, but these same fruits and vegetables, as we shall learn later, may prove indispensable to life because of their alkaline, mineral and vitamine contents.

It is beyond the scope of this treatise on the normal diet to discuss at length the treatment of constipation and the many forms of colitis. All patients must of course stop the use of cathartics. In one group, we may place those patients who complain merely of a lack of natural bowel movements and in whom there is no marked tenderness over the anatomical course of the colon. When such patients are given the normal amount of bulk, and simultaneously they are persuaded to wait the proper length of time for such bulk to act naturally, they will usually have natural movements. As such natural movements continue, the use of cathartics is discontinued and present and future trouble is avoided. Occasionally, a patient is found who is eating the normal

amount of fruits and vegetables and only needs to omit the cathartics.

In another group, we may place those patients who have a moderate degree of pain over the colon, and who, when advised to eat an adequate amount of fruits and vegetables, claim that they cannot do so because of the resultant distress. Such distress is not due primarily to these natural foods, but to the irritated condition of the bowel. Obviously, the first essential in the treatment of such conditions is the elimination of the irritating cathartic substances, when if adequate bulk is given in the form of cooked and finely divided fruits and vegetables, favorable progress is usually made. If the large bowel has become spastic, it may be necessary to put the patient to bed and serve a non-residue diet until the colon is rested. Soothing bowel powders are given by mouth and heat is applied to the abdomen until the spasticity is relieved. Small quantities of the less bulky foods, cooked and finely divided, may then be added cautiously. It should be remembered that in many cases it has taken years to bring about such a serious condition, and, in consequence, it may require many months of careful management to restore the bowel to its normal state.

In a third group, we may place those patients who seek advice because of a continual diarrhea. They state that for many years they were constipated and took large doses of cathartics, but that more recently the reverse condition has prevailed. Under such conditions, chronic inflammation of the bowels may be found. The stools may contain large amount of mucus, and even blood and pus. These patients need a long course of very soothing management.

In the beginning of a course of dietary treatment for

constipation some patients complain of a "stuffed" feeling. Whereas in the past, the abdomen had been kept unnaturally empty, it is now restored to a natural state. Others find difficulty in consuming an adequate amount of bulk because the stomach has become abnormally small, but the stomach also, will early assume its natural capacity, which is in the neighborhood of three pounds or three pints. Many individuals become impatient and are unwilling to wait the necessary length of time for the bowels to act unaided, or it may be that a natural movement is prevented because the rectum is filled with impacted masses of feces. It is often advisable, during the first few days of treatment, sometimes termed "the weaning stage," to use something to empty the rectum only. The oil-retention enema is used for this purpose. Three to six ounces of cotton-seed oil are injected into the rectum in the evening and left there until the next morning, when it is easily expelled with the softened fecal matter. The injection is made by means of a rectal tube and funnel. Sippy[3] is responsible for the following rules governing the use of the oil enema: "The oil enema should be used at bed-time, (1) when there has been no stool during the entire day, (2) when the stool that day has been hard and dry. If the oil enema has been neglected in the evening, and there is no inclination to go to stool the next morning, a bowel movement may be obtained by using a glycerin suppository or the injection of one-fourth to one-half pint of normal salt solution. If this is not sufficient, a pint may be used, but a copious flushing must not be taken." The normal salt solution is prepared by the addition of a level teaspoonful of table salt to a pint of warm water.

The normal stool should be soft but formed, of about

the consistency of butter at average room temperature, and should weigh approximately five or six ounces. Many patients are not satisfied with a stool of normal size but expect the copious, cathartic stool to which they have been accustomed. One need not worry if there has been no stool on any particular day provided the subsequent stool is soft but formed. On the other hand, two or three movements may be had in the day provided they are of this proper consistency.

Many patients come to me complaining of a "dropped" stomach. X-ray pictures taken after a thorough emptying of the bowels when barium is used for diagnostic purposes, usually do show the stomach lower down than its normal position. I have seen many such x-ray pictures in patients with the cathartic habit where the stomach is down in the pelvis. Such low-lying stomachs may cause a certain amount of vague distress and they are often treated by keeping the patients in bed with their feet higher than their heads or by the use of cumbersome abdominal supports. When patients are taking an adequate amount of residue-containing foods and the colon is filled to its normal capacity, such stomachs are pushed back up and maintained at their normal positions.

It must not be understood from the foregoing paragraphs that cathartics have no place in medicine. They should certainly be used freely in any case where intestinal poisoning is suspected. Spoiled foods, especially the meats, often cause severe abdominal distress which is sooner or later followed by diarrhea. Enemas and cathartics should then be used freely to eliminate as rapidly as possible the poisonous material. Cathartics are often considered advisable in infectious diseases,

especially those associated with fever, to bring about elimination by means of a thorough emptying of the alimentary tract. Again, mild laxatives have a place following surgical operations, especially upon the alimentary tract, when it is often unwise to fill the bowel with masses of indigestible residue. The practice of giving a drastic cathartic previous to surgical operations is not now adhered to as in the past. Surgical patients oftentimes needlessly continue the use of cathartics after recovery. It is the habitual and not the occasional use of cathartics which causes serious damage.

The menus of the first chapter are for normal and not anticonstipation diets. They contain much more bulk than is usually consumed by the average person but a constipated person may need still more, especially in the beginning of his treatment. If, in place of, or in addition to, the fruit juices listed in these menus, another fruit or vegetable is added to each meal, these menus may be made into anticonstipation diets.

In conclusion, if an individual is consuming sufficient of the residue-containing fruits and vegetables and whole grain products to insure one soft but formed stool per day, unaided by artificial means, the bulk requirements of the body are properly satisfied.

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CHAPTER III

THE ACID-ASH TYPE OF ACIDOSIS

The normal diet should contain an adequate amount of the alkaline-ash foods to balance the acid-ash foods.

The term *acidosis* was used originally to designate a condition in which acetone bodies were found in the urine. It is now used more generally to indicate any condition in which the body is less alkaline than it should be. The living body is always slightly alkaline. If the tissues of the body become acid to the slightest degree, death occurs, and serious illness results long before the alkalinity of the body is reduced to the neutral point.

The more common symptoms of the acid-ash type of acidosis are malaise, lassitude, nausea and later vomiting, loss of appetite, headaches, weakness, sleeplessness, muscle aches, acid mouth, sour stomach, acid urine, acid sweat, "sour disposition," and, I believe, the blood vessel disease which is responsible for high blood pressure and such complications as partial blindness, heart disease, kidney disease, gangrene and apoplexy.

Headaches are usually due to eye strain, chronic sinus disease or to a too acid diet regime. In many instances I have found that headaches of the so-called migraine type and which are supposed to be hereditary, are due to a too acid dietary.

Dentists complain about acid mouths and their relation to dental hygiene. Some makers of tooth paste attempt to correct the mouth condition by the use of alkaline tooth pastes.

Sour stomachs are unusually common. Ulcers of the stomach usually cause excessively sour stomachs but positive diagnoses of ulcer of the stomach should be made with the x-ray before a long course of ulcer management is prescribed. During the past six months I have had forty patients whose stomachs were so excessively sour that ulcers might very well have been suspected. I have had gastrointestinal studies made by means of the x-ray in all of these forty patients and in only four was a positive diagnosis of ulcer made. Many of these patients without ulcer had been treated for ulcer with no permanent benefit. The troublesome belching of gas is undoubtedly due to a too sour stomach which reflexively causes an excessive flow of saliva. As this saliva is swallowed, air is swallowed with it, thus causing the gas which is later belched up.

I believe that the urine passed should be nearly neutral or about twice as acid as the body. It burns when it becomes one hundred times as acid as the body, and yet urines one thousand times as acid as the body are found.

The sweat may be sufficiently acid to cause "sweat burn" under the arms, and the manufacturers of silk hose state that sour sweat is often the cause of the rapid deterioration of good silk.

Dispositions are more or less intangible, but at the same time I have many apparent improvements to my credit.

The relation of acidosis to blood vessel disease will be discussed later in this chapter.

Every one is aware that when fuel is burned, an ash remains. Almost every one appreciates that the food which we eat is digested, absorbed, and burned in the body, but many do not know that when this food is

burned in the muscles of the body, an ash results of exactly the same type as is found when food is burned outside of the body. Under normal condition, sugars, starches, fats and the major portion of the proteins are burned to carbonic acid. This is a respirable acid and is automatically eliminated with each respiration. It is produced in large quantities and has no effect upon the alkaline balance of the body as long as it can be promptly eliminated. If breathing should be prevented for a few moments, however, death would soon result from a carbonic acid type of acidosis. This type frequently prevails in pneumonia when the function of respiration is interfered with by the lung condition. It is often found in heart disease when the venous blood laden with carbonic acid is not adequately circulated through the lungs.

In addition to this carbonic acid, the oxidation of all foods produces an ash. This ash is nonrespirable and may be neutral, acid or alkaline. The soluble ash content of foods is excreted largely by the kidneys. If foods containing an acid-ash predominate in the diet, and if this ash is not properly eliminated by the kidneys it will gradually reduce the alkalinity of the body and produce acidosis. We generally eat what foods we please regardless of the nature of their final reaction and leave to the kidneys the function of regulating the alkaline balance of the body. Excessively acid urines usually mean either the overconsumption of the acid-ash foods or the underconsumption of the alkaline-ash foods.

In order to understand the acid-ash type of acidosis, a knowledge of the ash of foods must therefore be gained. The taste of food is no guide to its final reaction in the body. The sourest lemons, grapefruit or

oranges prevent acidosis, and bread, which tastes neither acid nor alkaline, is one of the most potent factors in producing a serious acidosis. Lists of foods showing the net ash content have been prepared by Sherman and Gettler[1] and tested in man by Blatherwick.[2] The tables which follow have been prepared from their work.

The Neutral-Ash Foods

These may be used in any amount desired unless otherwise stated. Individuals who are overweight should always eat very sparingly of those foods containing the various forms of fat, even though the ash is neutral.

Butter
Cornstarch
Cream
Lard
Sugar
Tapioca

The Acid-Ash Foods

These foods should always be balanced by adequate amounts of alkaline foods. When the urine is excessively acid, many of them should be omitted, at least for a time. In certain diseases, such as blood vessel disease of which high blood pressure is a common symptom, they should be reduced to a minimum or omitted altogether. In the table which follows the excess of acidity is expressed in cubic centimeters of a gram-molecular solution per 100 grams of the substance. For practical purposes, the numbers opposite the various foods may be considered as comparable degrees of acidity. Thus, a 100 gram portion of oysters has 30

degrees of acidity. Chicken (17.01) is more acid than beef (13.91).

	PER 100 GRAMS
Bread	7.1
Bread, whole wheat	7.3
Corn, sweet, dried	5.95
Crackers	7.81
Cranberries	*
Eggs	11.10
Egg white	5.24
Egg yolk	26.69
Fish, haddock	16.07
Fish, pike	11.81
Meat, beef, lean	13.91
Meat, chicken	17.01
Meat, frog	10.36
Meat, pork, lean	11.87
Meat, rabbit	14.80
Meat, veal	13.52
Oysters	30.00
Oatmeal	12.93
Peanuts	3.9
Prunes, plums	*
Rice	8.1

The Alkaline-Ash Foods

In general, all fruits (with the exception of prunes, plums and cranberries), vegetables, nuts and milk are alkaline in their final reaction in the body. The acidity of prunes, plums and cranberries is inconsequential except in certain seriously diseased conditions. The foods listed in the table should always be used in adequate amounts to maintain a favorable alkaline balance of the body.

*The ash of these foods is alkaline but because of contained substances which form hippuric acid in the body, they increase the acidity of the urine.

	PER 100 GRAMS
Almonds	12.38
Apples	3.76*
Asparagus	.81
Bananas	5.56*
Beans, dried	23.87*
Beans, lima, dried	41.65
Beets	10.86
Cabbage	4.34
Carrots	10.82
Cauliflower	5.33
Celery	7.78
Chestnuts	7.42
Currants, dried	5.97
Lemons	5.45
Lettuce	7.37
Milk, cow's	2.37*
Muskmelon	7.47*
Oranges	5.61*
Peaches	5.04
Peas, dried	7.07
Potatoes	7.19*
Radishes	2.87
Raisins	23.68
Turnips	2.68

The reader will note that the citrus fruits, lemons and oranges, are included in the list of alkaline foods. Grapefruit and limes will be added to this list when their ash content has been definitely established. These fruits are distinctly acid in taste and are usually avoided by patients suffering from an acidosis because of their acidity. However, the acids of these fruits, which are chiefly the citric and malic acids, combined in the form of salts with such alkaline substances as sodium and potassium, are promptly oxidized by the

*These foods have been found experimentally to be very efficient in reducing the acidity of the urine.

body to the respirable carbonic acid which is exhaled, leaving an alkaline ash.

In 1921, Blatherwick and Long[3] found it impossible to give sufficient orange juice to overstep the power of the body to utilize these organic acids. Two healthy individuals, one a nurse and the other a member of our chemical staff, volunteered for the experiment. The chemical reaction of the blood and urine was first carefully determined on a standard diet. Six large oranges were given on the first day of the experiment, and six large oranges were added on each successive day until the experimenters were taking twenty-four large oranges daily. At the beginning, the urine was acid, and at the end it was distinctly alkaline. The alkalinity of the blood steadily increased from day to day.

The orange growers are correctly using such scientific data when they assert in their advertisements that, "Although known as acid fruit, oranges have an alkaline reaction in the blood which offsets the acidity caused by such good foods as meat, fish and eggs." They should add cereals and breads to their statement. In preventing or curing an acidosis, oranges together with apples, muskmelons, bananas and potatoes are very efficient. Too much cannot be said about the value of fruits in a diet, for in addition to their alkalinizing effect, they have a high food value and contain an abundance of the minerals and vitamines.

My first conception that the acid-ash foods might bear a relation to high blood pressure occurred six years ago when I became acquainted with the above food ash analyses of Sherman and Gettler and the studies in urine acidity made by Blatherwick. Blatherwick proved that the acidity of the urine can be changed at will, the change paralleling the ash of the foods used.

Untreated high blood pressure patients usually have very acid urines. These urines are oftentimes from one hundred to as high as one thousand times as acid as the body. A standard treatment for high blood pressure has been the administration of alkaline drugs or waters to counteract such abnormal acidities. With the knowledge that food alone might be responsible for abnormally acid urines, it seemed logical to ascertain whether such acid urines might not be corrected by diet alone.

This experiment was first tried on a woman 63 years of age, who was admitted with a blood pressure of 240, shortness of breath, a very sour stomach, and an abnormally acid urine. She was given what we now call a basic diet, that is, a diet containing very limited amounts of the less acid-ash foods, ample amounts of the alkaline-ash foods and the neutral-ash foods as desired. In the course of a few days her urine lost all of its excess acid and, very much to my surprise, her blood pressure began to decrease steadily. Eventually, it fell to as low as 145 and has remained within a range of 145 to 180 for the past five and one-half years. In the meantime, the patient has felt well and has led a normally active life. She is now seventy years of age. Encouraged by this result, I treated a series of fifty high blood pressure patients with diet alone and in all cases was able to produce a neutral urine, and in 90 per cent of the cases, the blood pressure fell on an average of forty to fifty points. Only the terminal cases with very marked sclerosis (hardening) of the blood vessels and excessive kidney damage failed to respond satisfactorily.[4]

Four years ago we began a series of experiments[5, 6, 7] on rabbits to ascertain whether the blood vessel and

the kidney damage which is responsible for high blood pressure could be produced in such animals by unbalanced diets. These preliminary experiments have been successful.

For our control we chose twelve healthy, young rabbits. These rabbits were given a balanced diet consisting of grain and alfalfa hay. The grain has an acid-ash and the alfalfa hay has an alkaline-ash. During the two years of this experiment, these rabbits, with the exception of one which died from pneumonia, remained in excellent health. They gained weight as they should. Their blood pressures were taken each month and remained essentially normal. Their urines were slightly alkaline. There was no retention of waste products in the blood. When these animals were killed and the tissues carefully studied microscopically, there was no evidence of the type of blood vessel or kidney disease which is the cause of high blood pressure.

The second group of twelve healthy, young rabbits were given a diet consisting of grain, having an acid-ash, together with minor additions to prevent the so-called deficiency diseases. These rabbits did not grow well. Seven of them died during the course of the two-year experiment. Every rabbit that lived longer than a period of eight months developed high blood pressure and Bright's disease with albumin in the urine and retention of sewage products in the blood. The remaining five were killed and the tissues have since been studied, together with the tissues of all of those that died earlier in the course of the experiment. Depending upon the length of life, the blood vessels show increasing degrees of the same type of blood vessel damage which is seen in human beings afflicted with high blood pressure. The kidneys show the same type of

kidney disease which is seen in patients dying from this type of disease.

The third group of twelve healthy, young rabbits was started later. They were given a diet consisting essentially of grains and meat. For this experiment, liver was used and was baked, ground, dried and mixed with the grain. Minor additions were made to the diet to prevent the so-called deficiency diseases. During the course of this shorter experiment of fourteen and one-half months, eleven rabbits died. Increases in blood pressure were noted at the end of the third month. The blood pressures were much higher, averaging nearly 100 per cent above normal. The sewage retention in the blood was much higher. The care of the rabbits was very difficult, for many of them were sick the greater part of the time. Gross and microscopic findings were even more marked than in the grain series.

I believe that considerable acidosis is produced by the consumption of excessive amounts of bread and that still more serious degrees of acidosis may be produced by the eating of too much bread and meat. This is true especially when the bread or the bread-and-meat diets are not adequately balanced by ample amounts of the alkaline-ash foods, such as fruits, vegetables and milk.

Many people believe that blood vessel disease is due to overconsumption of protein foods. The above unbalanced diets were high in protein foods, and to prove that high protein in itself is not the cause of blood vessel disease, we started a fourth group of twelve healthy, young rabbits on a high protein, excessively alkaline diet, consisting essentially of ground soy beans. These diets were as excessively alkaline as the other diets were excessively acid. The rabbits developed serious Bright's

disease and all of them died during the twenty months of the experiment. The gross and microscopic findings showed no evidence of the type of blood vessel disease which is associated with high blood pressure. Excessively alkaline urines from diet sources, however, are rarely seen in humans. I recall but one instance, that of a very strict vegetarian who came to me complaining of headaches and in whom I found an excessively alkaline urine.

I believe that the acid-ash type of acidosis is very commonly seen and I know that it may be easily controlled by the proper balancing of diets. We have not as yet proved that it is the cause of high blood pressure and its complications, but we certainly have advanced enough evidence to interest people in the avoidance of the acid-ash type of acidosis.

From the above statements one can readily understand that diet plays the most important rôle in the treatment of this form of acidosis. To prevent the acid-ash type of acidosis, individuals must balance their diets with ample amounts of fruits and vegetables. Less bread should be eaten, and more milk should be used in place of so much meat, fowl, eggs and fish. Individuals who are engaged in hard, manual labor will find beans especially valuable, both because of their high alkaline-ash and because of their nutriment.

Sodium bicarbonate (baking soda) may be used temporarily in most cases in level teaspoonful doses, repeated often. I tell my patients that they should always use soda liberally whenever in their experience they have found that it benefits them, but if they must continually take soda, it is proof that their diets have not been properly balanced. The universal use of baking soda not only indicates indirectly how generally

acidosis exists, but, because it gives relief, is proof of its efficacy in the treatment of this condition.

In the severe forms of this type of acidosis and especially those associated with high blood pressure and its complications, basic or alkaline diet menus should be used. These diets consist essentially of the alkaline-ash foods, fruits, vegetables, nuts and milk. Milk and milk products effectively take the place of meat, fish, fowl and eggs, but patients need a bread. In the past I have used soy bean muffins, but patients as a rule soon tire of them. I believe that I have found a solution of this difficulty in lima bean flour, which has been developed for me to a high degree of fineness by the California Lima Bean Growers Association of Oxnard, California. The lima bean is the most alkaline food known, containing 41.65 points of alkalinity. It is so alkaline that I believe that wheat flour, having an acidity of 9 points, may be safely mixed with it. Muffins, pancakes or waffles may be made by using equal parts of lima bean flour and white flour. Our bakers have recently developed an excellent health bread using two parts of wheat flour, one part of lima bean flour, together with raisins, nuts, yeast and such other ingredients which go into the making of bread. I am in hopes that this new non-acid bread will find a wide usage in both the prevention and treatment of this type of acidosis. The menus which follow offer a wide variation of foods from which to choose.

Basic Diets

1

Breakfast

Apple Sauce
Bacon
Lima Bean Bread Toast Butter
Orange Marmalade Glass Orange Juice
Glass Milk or Cocoa

Dinner

Browned Potatoes
Buttered Carrots Swiss Chard
Pineapple and Cottage Cheese Salad
with French Dressing
Lima Bean Bread Butter
Fresh Blackberries with Cream
Glass Orange Juice Glass Milk

Supper

Cream of Spinach Soup
Baked Potatoes Fresh Asparagus
Lima Bean Bread Butter
Fresh Apricots
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 345 grams, protein 65 grams, fat 80 grams, bulk 900 grams, calories 2360.

2

Breakfast

Grapefruit
Bacon
Lima Bean Bread Toast Butter
Jelly
Glass Orange Juice
Glass Milk or Cocoa

Dinner

Potatoes diced in Cream
Mashed Turnips Buttered Peas
Head Lettuce with French Dressing
Lima Bean Bread Butter
Fresh Raspberries with Cream
Glass Orange Juice Glass Milk

Supper

Cream of Tomato Soup
Baked Sweet Potato Fresh Spinach
Lima Bean Muffins Butter
Apple Cheese
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 320 grams, protein 60 grams, fat 90 grams, bulk 900 grams, calories 2330.

3

Breakfast

Baked Apple
Bacon
Lima Bean Muffins Butter
Cantaloup
Glass Orange Juice
Glass Milk or Cocoa

Dinner

Parsley Potato
Buttered String Beans Italian Squash
Combination Vegetable Salad
Lima Bean Bread Butter
Sliced Peaches with Cream
Glass Orange Juice Glass Milk

Supper

Cream of Celery Soup
Scalloped Potatoes Diced Beets
Lima Bean Bread Butter
Fresh Cherries
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 330 grams, protein 60 grams, fat 80 grams, bulk 1000 grams, calories 2280.

4

Breakfast

Banana with Cream
Bacon
Lima Bean Bread Toast Butter
Apple Sauce
Glass Orange Juice
Glass Milk or Cocoa

Dinner

Cream of Pea Soup
Whipped Potatoes
Baked Squash Buttered Celery
Peach Basket Salad
Lima Bean Bread Butter
Maple Nut Sundae
Glass Orange Juice Glass Milk

Supper

Cream of Asparagus Soup
Buttered Carrots and Peas
Creamed Turnips Sliced Tomatoes
Lima Bean Bread Butter
Ripe Pear
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 345 grams, protein 65 grams, fat 85 grams, bulk 1000 grams, calories 2405.

5

Breakfast

Cantaloup
Bacon
Lima Bean Muffins Butter
Stewed Raisins Glass Orange Juice
Glass Milk or Cocoa

Dinner

Split Pea Soup
Candied Sweet Potatoes
Puree Beets Fresh Spinach
Lima Bean Bread Butter
Frozen Apricots
Glass Orange Juice Glass Milk

Supper

Creamed Potatoes
Buttered String Beans
Banana and Orange Salad
Lima Bean Bread Butter
Grapes
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 360 grams, protein 60 grams, fat 80 grams, bulk 900 grams, calories 2400.

6

Breakfast

Fresh Figs
Bacon
Lima Bean Bread Toast Butter
Strawberry Jam
Glass Orange Juice Glass Milk or Cocoa

Dinner

Cream of Celery Soup
Scalloped Potatoes
Baby Lima Beans Swiss Chard
Pickled Beet Salad
Lima Bean Bread Butter
Sliced Peaches with Cream
Glass Orange Juice Glass Milk

Supper

Cream of Carrot Soup
Buttered Peas Banana Squash
Pineapple Salad
Lima Bean Bread Butter
Junket Nuts
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 320 grams, protein 65 grams, fat 110 grams, bulk 900 grams, calories 2530.

7

Breakfast

Baked Apple
Bacon
Lima Bean Bread Toast Butter
Grapes
Glass Orange Juice Glass Milk or Cocoa

Dinner

Cream of String Bean Soup
Baked Potato
Creamed Carrots Buttered Fresh Asparagus
Tomato Salad with French Dressing
Lima Bean Bread Butter
Honey Dew Melon Cluster Raisins
Glass Orange Juice Glass Milk

Supper

Potato Balls with Parsley Sauce
Creamed Salsify Spinach
Lima Bean Muffins Butter
Apricot Charlotte
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 380 grams, protein 60 grams, fat 80 grams, bulk 1000 grams, calories 2480.

8

Breakfast

Fresh Raspberries with Cream
Bacon
Currant Jelly
Lima Bean Bread Toast Butter
Glass Orange Juice Glass Milk or Cocoa

Dinner

Cream of Cauliflower Soup
Mashed Potatoes
Artichoke Beet Greens
Combination Fruit Salad
Lima Bean Bread Butter
Apple Tapioca
Glass Orange Juice Glass Milk

Supper

Stuffed Potatoes
Baked Tomatoes Buttered String Beans
Lima Bean Bread Butter
Blackberries
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 330 grams, protein 60 grams, fat 75 grams, bulk 900 grams, calories 2234.

9

Breakfast

Sliced Peaches
Bacon
Lima Bean Muffins Butter
Raspberry Jam
Glass Orange Juice Glass Milk or Cocoa

Dinner

Cream of Onion Soup
Browned Potatoes
Creamed Cauliflower Parsnips
Waldorf Salad
Lima Bean Bread Butter
Pineapple Ice
Glass Orange Juice Glass Milk

Supper

Potatoes au Gratin
Buttered String Beans
Tomato and Cottage Cheese Salad
Lima Bean Bread Butter
Canned Figs
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 355 grams, protein 65 grams, fat 90 grams, bulk 900 grams, calories 2490.

10

Breakfast

Fresh Strawberries
Bacon
Lima Bean Bread Toast Butter
Cherry Preserves
Glass Orange Juice Glass Milk or Cocoa

Dinner

Mashed Potatoes
Brussels Sprouts Mushrooms
Chicory Salad
Lima Bean Bread Butter Celery
Glass Orange Juice Glass Milk
Fresh Apple with Cheese

Supper

Cream of Celery Soup
French Fried Potatoes Broiled Onions
Lima Bean Muffins Butter
Iced Peaches
Glass Orange Juice Glass Milk

Approximate composition and caloric value: Carbohydrate 315 grams, protein 60 grams, fat 80 grams, bulk 900 grams, calories 2220.

Lima Bean Muffins

½ Cup White Flour
½ Cup Lima Bean Flour
⅔ Cup Milk
4 t. Sugar
4½ t. Butter
2 t. Baking Powder
½ t. Salt

Mix dry ingredients. Add milk and melted butter. Bake in a moderate oven. Makes 10 muffins. Nuts, raisins or dates may be added if desired.

The lima bean flour may be secured from the California Lima Bean Growers Association of Oxnard, California, and they will furnish recipes for the making of bread.

Fruit Punch

Many delicious and differently flavored fruit punches may easily be made according to the plan which follows. These punches may be used in place of orange juice although patients seldom seem to tire of orange juice.

Juice from 2 Oranges 2 Cups Water
Juice from 2 Lemons or 1 Grapefruit
Sugar or Honey to Taste

For flavoring, add to the above 1 cup other Fruit Juice, such as Grape Juice, Loganberry Juice, Pineapple Juice, Cider or the juice from any canned fruit.

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CHAPTER IV

THE ACETONE TYPE OF ACIDOSIS

The normal diet should contain an adequate amount of the starches and sugars to prevent the acetone type of acidosis.

The symptoms of this type of acidosis are any or all of the symptoms mentioned under the acid-ash type, and specificially, sluggishness, headache, nausea, vomiting, coma and death.

The acetone type of acidosis is frequently the cause of death from coma in severe and mismanaged cases of diabetes. This type of acidosis may be due to the overconsumption of fat, the underconsumption of sugar, or to the disease, diabetes. It is due to the improper and incomplete combustion of fat. Fat is not completely oxidized in the body to the respirable carbonic acid except in the presence of burning sugar. Shaffer[1] has shown that the complete avoidance of the acetone type of acidosis cannot be accomplished unless the individual is burning one part of carbohydrate to each part of fat. The diabetic patient loses part or all of his ability to burn sugar which passes through unconsumed in the urine. Hence he is unable to burn his fat properly. In conditions other than diabetes, this type of acidosis is due either to the overconsumption of fat or to the underconsumption of the starches and sugars which are collectively known as the carbohydrates. While individuals are at the present time demanding and consuming more and more fat, they are at the same time consuming less carbohydrate than they should.

The chief sources of fat are rich milk, butter, cream,

cheese, fat meat, bacon, lard, suet, nuts, egg yolks, olive and vegetable oils. These sources have come to receive greater attention than ever before. The prize dairy cows are the ones that give the highest percentage of cream. We are not content with rich, whole milk, but demand butter and cream, thus forcing the farmer to feed the skim milk to his pigs. I believe that the selective breeding of cows to give richer milk is a step in the wrong direction and all pediatricians agree that cow's milk cannot be fed to babies unless it is diluted with water and sweetened with some form of sugar. Partially skimmed milk is far better for the undernourished child than whole milk. The cream mixed with sugar and flour may be made safe in the form of cookies. I often recommend the use of milk from Holstein cows because of its more nearly natural fat content. Fat livestock takes the blue ribbons and brings the highest market price. The olive growers of the world have been unable to supply the demand for table oils and now large quantities are extracted from corn, cotton-seed and cocoanuts.

Rich (fat) cooking is in greater demand. When we eat potatoes we like them creamed, garnished with butter and smothered with gravy. Many desserts are served with whipped cream. Salads are usually served with either French or mayonnaise dressing in which large amounts of vegetable oils are used. We buy the fattest young chickens and turkeys, garnish them with strips of bacon and baste them with butter. Lard alone, or lard with butter, is used in the making of all kinds of pastries and in the frying of food.

During the World War, when millions of men were changed from civilian rations consisting of 2500 to 3500 calories to the army rations consisting of 5500 calories,

with their higher ratio of four parts of carbohydrate to one part of fat, there was a marked shortage of carbohydrates. The warring nations, therefore, limited the home consumption of white flours and sugars. These limitations were made, not because the white flours and sugars were injurious for home consumption, but because they were so necessary to make up an adequate army ration. People stopped using these carbohydrate foods for patriotic reasons and many of them have not as yet resumed their adequate use.

Army officers and athletes seem to appreciate more than all others the incapacitating effect of overweight and rich diets. When a man becomes fat competition soon places him in the discard. Whereas 3500 calories per day is sufficient for a man doing average work, and 5500 calories is the army ration, our college football players often use up 8000 calories during a game. They enter such games without food or with a very light lunch. Their energy comes from the burning of their own lean meat, and the more muscular they are the more endurance they seem to have. In the strenuous boxing ring many a comparatively young man has been knocked out by a less experienced and lighter man because he has permitted himself to become fat. Athletes are advised not to drink milk because it is said to "slow them up." It is the fat of the milk which "slows them up" and not the sugar as was formerly supposed. The diet of the athlete should be high in carbohydrate and low in fat. Sugar in some form or other is now being given during long runs or swims and during rest periods in other athletic sports.

Under nondiabetic conditions, the acetone type of acidosis occurs most commonly under circumstances characterized by starvation and semi-starvation, as in

the involuntary type sometimes due to vomiting which so often accompanies childhood diseases, pregnancies, and surgical operations. Complete starvation is rare, except on such occasions as famine, mine accidents or shipwrecks, but voluntary, partial or complete starvation is practiced, especially in individuals who attempt to reduce either by starvation or by the elimination of the starches and sugars from their diets. During starvation and in proportion to its severity, the body is sustained by the consumption of its own fat and protein. Fat, unbalanced by sufficient carbohydrate, gives rise to the acetone type of acidosis in varying forms of severity.

This type of acidosis is responsible for what I call in women "shoppers' headache." Contemplating a shopping trip for the day, women rise earlier than usual and, in their hurry, oftentimes eat little or no breakfast. Entering the strenuous life of the city, they begin shopping at once. As often before, they have a severe headache long before noon and are almost overcome with fatigue. They should have prepared themselves for these extraordinary activities by eating an unusually large breakfast. Not having been given sufficient food, the body sustains itself by burning a large amount of its own fat and protein. These are not balanced by adequate carbohydrate and an acidosis results. Acidosis causes headaches, nausea, and even vomiting. Thus we have a vicious circle: the greater the acidosis, the more difficult it is for the individual to take and retain food; and, without the burning of carbohydrate, the acidosis becomes progressively worse. In these instances, added to the acetone type of acidosis, there is the acid-ash type caused by consumption of the individual's own protein tissue.

A severe degree of the acetone type of acidosis com-

monly occurs in children. Many diseases of childhood manifest their onset by severe nausea and vomiting. In the presence of fever, one has an increased caloric consumption which, because of the impaired appetite and the vomiting, must be largely supplied from the body fat and protein. Then, although the initial cause of the nausea may cease to act, the resultant acidosis causes the vomiting to persist, sometimes to a temporarily uncontrollable degree, and again, on the principle already described, a vicious circle is again established. Not long ago I was called in consultation to see a boy who was in a stupor. The physicion had noted the acetone odor on entering the room and had found an alarming amount of acetone and diacetic acid in the urine. The boy had a fever of 105.6 degrees. The mother had been wrongly advised to keep the child on a very low carbohydrate diet. He had been given neither sugars nor foods sweetened with sugar, but had been fed large amounts of such fats as butter, cream, and olive oil. He had had several similar attacks before, but none quite so severe as this. The boy needed sugar to counteract the acetone type of acidosis, and water because the fever was a dehydration fever from vomiting. I advised lemonade, because, under such circumstances, sour drinks are usually retained. If the vomiting is too severe, pieces of lemon or grapefruit dipped in sugar provide ample carbohydrate. Because it contradicted her former teachings, his mother was surprised when I ordered an acid drink in the presence of the acidosis and when I advised liberal amounts of sugar. Fruit juices, however, are excellent in the treatment of such forms of acidosis because, as explained before, they have an alkaline reaction in the body. The sweetened lemonade, which fortunately the boy was able

to retain, dissipated both the acetone type of acidosis and the fever. The next day he was playing out-of-doors.

In the early months of pregnancy, the enlarging of the uterus often causes a reflex type of vomiting. This does not become alarming unless it robs the prospective mother of the ability to take and retain sufficient carbohydrate food to prevent the onset of acidosis. When acidosis occurs, however, the reflex vomiting may be aggravated beyond control, and again the vicious circle is established. Some of the most serious degrees of the acetone type of acidosis that I have ever seen have occurred in women at this stage of pregnancy. Pregnant women must carefully avoid overweight. They are usually advised to eliminate starches and sugars from their diets when they should be advised to eliminate nearly all of the fats.

Following surgical operations, acetone bodies in abnormal amounts were found by Farrar[2] in 72 per cent of all his cases. Sometimes nausea and vomiting are the initial symptoms in abdominal surgical conditions. Following operations, it is usually inadvisable to give food until the anesthetic has been eliminated from the system. But unless carbohydrate food is given early, the inevitable acidosis insidiously begins. This, together with the nausea produced by the anesthetic and the operation, increases the tendency to vomiting, which may become uncontrollable. At the present time nearly all surgeons are continually on the lookout for this type of acidosis and carbohydrates are being given freely before operations, and intravenously during and following operations. Glucose enemas are given before the patient is able to swallow fluids by mouth, and as soon as possible fruit juices are given by mouth.

This type of acidosis very commonly reaches a serious stage when obese individuals, either realizing the seriousness of overweight, or because of vanity, attempt to lose weight too rapidly. As is frequently the case, they either starve, or omit nearly all starches and sugars from their diets. The large amount of body fat oxidized is so inadequately balanced by burning carbohydrates, that a degree of acidosis may be produced sufficient to seriously damage the heart.

We are just beginning to learn that even the diabetic patient should have at least two parts of carbohydrate to one part of fat in the diet.[3]

In the prevention and treatment of this form of acidosis, ample starches and sugars must be used, and a radical attempt should be made to prevent the ever-increasing overconsumption of fat. Adults doing ordinary work seem to thrive on diets containing two parts of carbohydrate to one part of fat. The normal diet menus of the first chapter were built with this principle in mind. The fighting ration used by the United States army during the World War contained four parts of carbohydrate to one part of fat. Experience has taught that such high carbohydrate diets make the most efficient soldiers. Children may very well need a similar ratio. I believe that their desire for extra sweets may be a natural craving for the foods which they need. Such diets may be easily built from the above mentioned normal diet menus by the addition of jams, marmalades, jellies, extra fruit juices, syrups, honey, cookies, plain cakes, sugar on breakfast foods and even in their milk, and the use of plain candy after meals, although the candied fruits should be preferred to the candy itself. Bread and butter and jam is a better food combination for a child than bread and butter alone.

Reducing diets must be surprisingly low in calories because fat individuals need so little food. This reduction in calories must be made by the elimination of fat from the diet rather than the elimination of carbohydrate. For every unit of weight that a patient may wish to lose and for every unit of fat included in his diet, he must eat an equal amount of carbohydrate. To lose a pound in weight safely, one must eat a pound of carbohydrate. On nearly fat-free diets of only 1000 calories, accompanied by an adequate amount of exercise, we have shown that one can lose safely as high as twenty pounds per month.[4, 5]

The diet menus which follow are included here for those who are overweight. They are the type of diets so enthusiastically endorsed by Mr. Samuel G. Blythe in his article entitled "Get Rid of That Fat," which appeared in the April 23rd, 1927 issue of the *Saturday Evening Post*. They violate none of the normal diet principles except the one pertaining to calories. Adequate calories in addition to those in the diet are supplied from the patient's own fat as he loses weight.

Safe Reducing Diets

1

Breakfast

Sliced Oranges—2 Small
Egg—1 Butter—½ square
Bread—1 Slice (Toasted)
Skim Milk—1 Glass
Coffee or Tea (Clear)

Dinner

Consomme
Roast Beef—1 Medium Slice
Spinach—3 Heaping Tablespoons
String Beans—3 Heaping Tablespoons
Asparagus and Lettuce Salad
(Ingredients: Asparagus, 12 Stalks; Lettuce, 2 Leaves, with Lemon, Vinegar or Mineral Oil Dressing.)
Sliced Peaches—6 Heaping Tablespoons
Skim Milk—1 Glass Tea (Clear)

Supper

Broth
Cottage Cheese—3 Heaping Tablespoons
Cauliflower—3 Heaping Tablespoons
Baked Tomato—1 Medium
Lettuce Salad
(Ingredients: Lettuce, ⅓ Head, with Lemon, Vinegar or Mineral Oil Dressing.)
Raspberries—6 Heaping Tablespoons
Skim Milk (1 Glass) Tea (Clear)

Approximate composition and caloric value: Carbohydrate 133 grams, protein 68 grams, fat 26 grams, bulk 1200 grams, calories 1038.

2

Breakfast

Cantaloup—½

Egg—1 Bread—1 Slice

Butter—½ Square Skim Milk—1 Glass

Coffee or Tea (Clear)

Dinner

Broth

Squab—1 Medium

Cream Squash—3 Heaping Tablespoons

Brussels Sprouts—3 Heaping Tablespoons

Tomato Salad

(Ingredients: Tomato, 1 Large; Lettuce, 2 Leaves, with Lemon, Vinegar or Mineral Oil Dressing.)

Fresh Pineapple—6 Heaping Tablespoons

Skim Milk—1 Glass Tea (Clear)

Supper

Cottage Cheese—3 Heaping Tablespoons

Spinach—3 Heaping Tablespoons

Fresh Asparagus—8 Large Stalks

Artichoke Salad

(Ingredients: Artichoke, 1 Medium; Lettuce, 2 Leaves, with Lemon, Vinegar or Mineral Oil Dressing.)

Baked Apple—1 Medium

Skim Milk—1 Glass Tea (Clear)

Approximate composition and caloric value: Carbohydrate 133 grams, protein 68 grams, fat 26 grams, bulk 1200 grams, calories 1038.

3

Breakfast

Orange—1 Medium
Corn Flakes—1 Medium Serving
Egg—1 Bread—1 Slice
Cream—1 Tablespoon
Skim Milk—1 Glass
Coffee or Tea

Dinner

Tomato Boullion
White Fish—1 Medium Serving
Beet Greens—3 Heaping Tablespoons
Riced Potatoes—3 Heaping Tablespoons
Lettuce Salad
(Ingredients: Lettuce, ½ Head, with Lemon, Vinegar or Mineral Oil Dressing.)
Strawberries—3 Heaping Tablespoons
Skim Milk—1 Glass Tea (Clear)

Supper

Half Broiler
Egg Plant—3 Slices
Baked Tomato—1 Medium
Celery—4 Stalks Banana—1 Medium
Skim Milk—1 Glass Tea (Clear)

Approximate composition and caloric value: Carbohydrate 132 grams, protein 68 grams, fat 24 grams, bulk 1000 grams, calories 1016.

4

Breakfast

Grapefruit—½ Medium
Puffed Rice—1 Medium Serving
Egg—1 Bread—1 Slice
Cream—1 Tablespoon
Skim Milk—1 Glass
Coffee or Tea

Dinner

Plain Broth
Broiled Trout—1 Medium Serving
Chiote—3 Heaping Tablespoons
New Peas—3 Heaping Tablespoons
Tomato Salad
(Ingredients: Tomato, 1 Medium, Lettuce, 2 Leaves, with Lemon, Vinegar or Mineral Oil Dressing.)
Raspberries—3 Heaping Tablespoons
Skim Milk—1 Glass Tea (Clear)

Supper

White Meat of Chicken—3 Slices
Creamed Squash—3 Heaping Tablespoons
String Beans—3 Heaping Tablespoons
Asparagus Salad
(Ingredients: Asparagus, 12 Stalks; Lettuce, 2 Leaves, with Lemon, Vinegar or Mineral Oil Dressing.)
Fresh Grapes—1 Medium Bunch
Skim Milk—1 Glass Tea (Clear)

Approximate composition and caloric value: Carbohydrate 132 grams, protein 68 grams, fat 24 grams, bulk 1000 grams, calories 1016.

5

Breakfast

Sectioned Oranges—2
Egg—1 Crisp Bacon—2 Slices
Bread (Toasted)—1 Thin Slice
Butter—½ Square Skim Milk—1 Glass
Coffee or Tea (Clear)

Dinner

Fresh Codfish—1 Medium Serving
Oyster Plant—3 Heaping Tablespoons
Cabbage—3 Heaping Tablespoons
Stuffed Tomato Salad
(Ingredients: Tomato [center removed] 1,
Lettuce, 2 Leaves, Diced Cucumber,
3 Heaping Tablespoons, Chopped Celery,
1 Tablespoon, Green Pepper, 1 Tablespoon,
with Lemon, Vinegar or Mineral Oil Dressing.)
Fresh Pineapple—2 Slices
Skim Milk—1 Glass Tea (Clear)

Supper

Sirloin Steak—1 Medium Serving
Broiled Onions—3 Medium
Celery—5 Stalks
Swiss Chard—5 Tablespoons
Fresh Red Raspberries—3 Heaping Tablespoons
Tea (Clear)

Approximate composition and caloric value: Carbohydrate 111 grams, protein 72 grams, fat 30 grams, bulk 1000 grams, calories 1002.

6

Breakfast

Muskmelon—½ Medium
Egg—1 Crisp Bacon—2 Slices
Bread (Toasted)—1 Thin Slice
Butter—½ Square Skim Milk—1 Glass
Coffee or Tea (Clear)

Dinner

Cottage Cheese—3 Heaping Tablespoons
Egg Plant*—3 Slices
Hubbard Squash—3 Heaping Tablespoons
Combination Salad
(Ingredients: Tomato, 3 Slices; Onion, ½ Teaspoon; Chopped Celery, 1 Heaping Teaspoon; Lettuce, 3 Leaves, with Lemon, Vinegar, or Mineral Oil Dressing.)
Canned Apricots—6 Halves
Skim Milk—½ Glass Tea (Clear)

Supper

Lean Meat of Lamb Chops—3 Medium
Diced Carrots—3 Heaping Tablespoons
Lettuce—½ Head Skim Milk—½ Glass
Canned Peas—3 Heaping Tablespoons
Pears—2 Halves
Tea (Clear)

Approximate composition and caloric value: Carbohydrate 111 grams, protein 72 grams, fat 30 grams, bulk 1000 grams, calories 1002.

*Egg plant sauted in mineral oil or broiled.

7

Breakfast

Oranges—2 Large (Sliced or Juice Extracted)
Bread (Toasted)—1 Thin Slice
Eggs—2 Butter—½ Square
Skim Milk—⅔ Glass
Coffee or Tea (Clear)

Dinner

Baked Ham—2 Medium Slices
Baby Lima Beans—2 Heaping Tablespoons
Summer Squash—3 Heaping Tablespoons
Cucumber and Green Onion Salad
(Ingredients: Cucumber, 12 Thin Slices;
Green Onions, 5; Lettuce, 2 Leaves;
with Lemon, Vinegar or Mineral
Oil Dressing.)
Baked Apple—1 Large
Tea (Clear)

Supper

Lobster—½ Cup
String Beans—3 Heaping Tablespoons
Cauliflower—3 Heaping Tablespoons
Bread—1 Thin Slice
Canned Pears—½ Pear
Skim Milk—1 Glass Tea (Clear)

Approximate composition and caloric value: Carbohydrate 115 grams, protein 68 grams, fat 30 grams, bulk 900 grams, calories 1001.

8

Breakfast

Grapefruit—1
Bread (Toasted)—1 Thin Slice
Eggs—2 Butter—½ Square
Skim Milk—⅔ Glass
Coffee or Tea (Clear)

Dinner

Tenderloin Steak—Small Serving
Mushrooms—3 Tablespoons
Tomato and Celery (Stewed)—4 Tablespoons
Asparagus Salad
(Ingredients: Asparagus, 12 Stalks;
Lettuce, 3 Leaves, with Lemon, Vinegar
or Mineral Oil Dressing.)
Watermelon—1 Medium Slice
Tea (Clear)

Supper

Black Bass (Planked)—1 Small Serving
Baked Potato—1 Medium
Cabbage Salad
(Ingredients: Lettuce, 2 Leaves; Green Pepper,
1 Teaspoon; Chopped Celery, 1 Heaping
Tablespoon; Chopped Cabbage, 3 Heaping
Tablespoons, with Lemon, Vinegar or
Mineral Oil Dressing.)
Sliced Orange—1 Medium
Tea (Clear)

Approximate composition and caloric value: Carbohydrate 115 grams, protein 68 grams, fat 30 grams, bulk 900 grams, calories 1002.

9

Breakfast

Rhubarb—3 Heaping Tablespoons
Bread (Toasted)—2 Thin Slices
Egg—1 Butter—½ Square
Skim Milk—1 Glass
Tea or Coffee (Clear)

Dinner

Chicken Broth—1 Cup
Roast Lamb—1 Medium Serving
New Peas and Potatoes—1 Medium Serving
Spinach—3 Heaping Tablespoons
Tomato and Lettuce Salad
(Ingredients: Lettuce, 2 Leaves;
Tomatoes, 1 Medium, with Lemon,
Vinegar or Mineral Oil Dressing.)
Tea (Clear)
Strawberries—3 Heaping Tablespoons

Supper

Assorted Cold Meats—1 Medium Serving
Hot Fresh Asparagus—10 Large Stalks
String Beans—3 Heaping Tablespoons
Head Lettuce Salad
(Ingredients: Lettuce, ⅓ Medium Head,
with Lemon, Vinegar or Mineral
Oil Dressing.)
Sliced Banana—1 Medium
Skim Milk—1 Glass

Approximate composition and caloric value: Carbohydrate 129 grams, protein 59 grams, fat 25 grams, bulk 1100 grams, calories 1004.

10

Breakfast

Grapefruit—1 Medium
Egg—1 Toast—1 Slice
Butter—½ Square Skim Milk—1 Glass
Tea or Coffee (Clear)

Dinner

Broiled Chicken—½ Medium
Mashed Potato—2 Tablespoons
Beet Greens—3 Heaping Tablespoons
Cucumber and Tomato Salad
(Ingredients: Lettuce, 2 Leaves; Cucumber, 12 Slices; Tomato, 1 Slice, with Lemon, Vinegar or Mineral Oil Dressing.)
Cantaloup—½ Medium
Tea (Clear)

Supper

Ham Omelet
(Egg—1 and lean diced Ham—2 Tablespoons)
Fresh Artichoke—1 Large
Summer Squash—3 Heaping Tablespoons
Celery and Radishes
(Celery—1 large Heart; and Radishes—4 Small)
Applesauce—3 Tablespoons
Skim Milk—1 Glass
Tea (Clear)

Approximate composition and caloric value: Carbohydrate 129 grams, protein 59 grams, fat 28 grams, bulk 1100 grams, calories 1004.

References

[1]Shaffer, P. A.: Harvey Lectures, 1922.
[2]Farrar, L. K. P.: Surg., Gynec. and Obst., 1921, xxxii, 8.
[3]Sansum, W. D., Blatherwick, N. R., and Bowden, Ruth: Jour. Am. Med. Assn., 1926, lxxxvi, 178.
[4]Sansum, W. D., and Bowden, Ruth: Western Dietitian (new Food Facts), 1926, i, 9.
[5]Sansum, W. D., and Bowden, Ruth: Better Health, January, 1926.

CHAPTER V

THE CALORIC REQUIREMENTS OF THE BODY

The normal diet should contain an adequate number of food units, or calories, to maintain the individual, under usual activites, at a normal weight for the age, sex and height. Overweight, as well as underweight, should be avoided.

The body may be compared to a stove. Wood, after being chopped, sawed, split or otherwise reduced to convenient sizes, is placed in the stove. The draught and the chimney damper are opened and the fire is lighted. The oxygen from the air unites with the wood in the process of burning. Carbon dioxide and water vapor are formed and pass up the chimney as smoke. Oftentimes, especially at the beginning, some of the carbon from the wood is not burned and hence the smoke is black. The ashes remain in the stove. In the body, the food corresponds to the wood or other fuel substance. In addition to its culinary preparation outside the body, it undergoes the complicated processes of digestion and absorption within the body. The oxygen inspired corresponds to the draught. This draught is more complicated than that of the stove because the oxygen taken in by the lungs must be carried by the blood to the various parts of the body, there to be united with the previously digested and absorbed food. In the body, carbon dioxide and water result from the burning, and these in turn are carried by the blood to the lungs and exhaled. The body brings about a more complete combustion than the stove, so that the exhaled breath is not

black with unburned carbon. The ash from the burned food is excreted by the kidneys. In the stove, burning takes place at a high temperature, whereas in the body, due to the influence of a substance known as insulin, it is brought about at the comparatively low temperature of the body.

The calorie is the unit used to express the heat or energy-producing value of food. It is defined as the amount of heat required to raise one liter of water one degree centigrade.

There are three groups of calorie-yielding food elements, the carbohydrates, the proteins and the fats. The carbohydrates include the starches and sugars. The proteins are the nitrogen-containing foods and are found most abundantly in meat, fish, shell-fish, eggs, milk and milk products, nuts, cereals, peas and beans. The fats may be of animal origin, such as butter, suet and lard, or of vegetable origin, such as the olive, corn and nut oils. One gram of carbohydrate has a food or heat value of four calories. One gram of protein has a food value of four calories. One gram of fat has a food value of nine calories.*

The following table indicates the daily food requirements of the average adult under varying conditions of rest and activity:

1000 to 1200 calories are essential for absolute bed-rest.

1500 calories may be considered an invalid's diet. The patient may be out of bed about four hours daily.

2000 to 2500 calories are sufficient for the usual activi-

*For a comprehensive study of food compositions, the reader is referred to Bulletin No. 28 of the U. S. Department of Agriculture, entitled "The Chemical Composition of American Food Materials," by Atwater and Bryant.[1] This bulletin may be obtained by sending ten cents in coin to The Superintendent of Documents, Government Printing Office, Washington, D. C.

ties of those engaged in light work, such as housekeeping, office work, salesmanship and professional duties. When the worker is confined closely indoors, an adequate amount of outdoor exercise should be systematically taken.

3500 calories are necessary for hard manual labor.

5500 calories constitute the fighting ration of the armies of the United States, Great Britain and Germany.

8000 calories are the food requirements of an Arctic explorer.

The following table indicates the daily food requirement for the average child under varying conditions of rest and activity.

700 to 1000 calories up to one year of age.
1200 calories from one to two years of age.
1500 calories from two to five years of age.
1500 to 2500 calories from five to ten years of age.
2500 to 5500 calories for adolescent youth.

It has always been generally understood that an adequate amount of food is necessary to the maintenance of life, and that the food requirements increase with physical activity. Modern science has brought to us refined methods of measuring these requirements. In the earlier work of Lavoisier (1777),[2] the calories given off by the body were measured directly as the quantity of heat given up to the air in a sealed room. This method, but with much more refined apparatus, is the best in use today. The room is called a respiratory calorimeter. By the use of the fully modernized, respiratory calorimeter, the number of calories given off from the body may also be measured indirectly from a knowledge of the oxygen consumed and of the carbon dioxide

eliminated. It requires definite amounts of oxygen to burn a gram of carbohydrate, a gram of protein, and a gram of fat, and from such combustions definite amounts of carbon dioxide are given off. The results by all of these methods agree within a fraction of a per cent. From such studies, many things have been learned.

If a person is lying quietly in bed fourteen hours after the last meal, the caloric requirements of the body are then at the lowest normal level. This is known as the basal metabolic rate. This basal rate varies with each individual from the average bed-rest requirement given in the table on page 83, but these variations follow definite rules, such as pertain to (1) surface area, (2) age, (3) sex, and (4) body-temperature.

1. *Surface Area.*—The most important variation is due to differences in the surface areas of our bodies. The heat lost from the body is directly proportional to the surface area, and is not proportional to the weight, as was for a long time supposed. Every one knows that a cup of hot liquid will cool much more rapidly if poured out in a thin layer than it will if left in a cup. The fact that all objects cool in proportion to their surface area has been known to students of physics for many years. This is known as Newton's Law. That this applied to the animate body as well was not appreciated until, in 1901, Voit[3] summarized the basal rate determinations that had been made on man and certain of the lower animals. His comparison of the basal rate determinations made on a man and a mouse illustrate this very well. The man, weighing 64.3 kilograms, was found to use 32.1 calories per kilogram of body weight and 1042 calories per unit of surface area, while the mouse, weighing, 0.018 kilograms, used 640 calories per kilogram of body weight and 1188 calories per unit of

surface area. Thus, in proportion to weight, the mouse used twenty times as much food as the man, but in proportion to surface area, it used only about 10 per cent more than the man. Such observations indicate why tall individuals need more food than do short persons of the same weight.

The unit of surface area used is the square meter. In the earlier work, the surface area of the body was calculated from numerous measurements, and later it was calculated from measurements made by means of an exactly-fitting, adhesive, tape coating which could be cut off and laid flat.[4] From such determinations, formulas have been arrived at and charts made, whereby, from the height and weight of an individual, the surface area of the body may now be calculated quickly with but a small percentage of error.

2. *Age.*[5]—Young people need more food than old people do, per unit of surface area. Thus, a child five years of age requires sixty calories per square meter of surface area each hour, while a person eighty years of age needs but thirty calories per square meter of surface area per hour.

3. *Sex.*[5]—Females require less food than males do, under the same conditions. For example, DuBois has shown that, between the ages of twenty and thirty, the hourly requirements of a female amount to 37.0 calories per square meter of surface area, while those of a male are 39.5 calories per square meter.

4. *Body Temperature.*[6]—The caloric requirements also vary with the average temperature of the body. DuBois has shown that this variation amounts to approximately 7 per cent for each increase or decrease of one degree Fahrenheit, above or below the normal level. This is

one of the reasons that patients lose so much weight during long-continued fevers.

Above the basal or bed-rest needs of the body, the food requirements increase in proportion to the physical activities of the individual, modified, of course, by such external factors as climate, clothing and housing. This is illustrated in the table of average food requirements on page 83.

One of the most striking additions to our knowledge concerning the food requirements of boys was made by Gephart[7] in a study of the food consumed by growing, athletic boys in a boarding school. They not only took a daily average of 4350 calories at the table, but they bought 650 additional calories at a neighboring store, making an average daily consumption of 5000 calories. This phenomenal requirement is the result of their development at this age, and, more important still, their strenuous activities. Criminologists in the large cities attribute much of the petty stealing of food to children whose hunger has been constantly unsatisfied. Parents too often make the mistake of allowing insufficient food to the active, adolescent child who may need fully as many calories as the father and mother together.

Undernutrition is often due to ignorance of the caloric requirements of the body under its many varied conditions of growth and activity. I believe that many people, especially women and children, cannot lead normally active lives because they do not eat sufficient food. It is often very hard to make the undernourished individual realize that the body is similar in principle to the automobile which requires gasoline in proportion as it is used. It is different from the automobile in that its combustion never ceases, even when it is at absolute bed-rest, as then the heart must continue to beat, breathing

must continue, and the body must be kept warm. It is different from the automobile, also, in that the fuel tank, the stomach, is smaller and requires fuel three times daily, whereas the gasoline tank on the automobile may be filled several times weekly. Regardless of how full the stomach may be filled, the food is all burned or built into body-tissue fourteen hours after the last meal. Still further, the body differs from the automobile which cannot run at all when out of gasoline, in that it can run for long periods of time by using up body-tissue, as evidenced by a continuous loss in weight. Many persons who would think it the height of folly to attempt a long journey with an empty gasoline tank, often start a hard day's work without breakfast, or without any more food in anticipation of a strenuous day than they would take previous to a day of comparative idleness.

School teachers are prone to eat irregularly, and oftentimes to miss meals, during the last strenuous weeks of a school year. In many instances, the major portion of the summer vacation is needlessly spent in recuperation.

That insufficient food is taken by many women who can well afford an ample amount, was convincingly brought out during the World War. Many who had led comparatively inactive lives, began then to assume a full share of the necessary, civilian war activities. They managed the drives, superintended community kitchens, and attended numerous meetings. Many did this without changing their usual habits of food consumption and consequently lost weight to a marked degree. Some suffered from headaches and others from what is commonly called "nervous breakdown." Usually these "nervous breakdowns" were due entirely to the com-

bination of a lack of sufficient food and worries that were inordinately magnified because of illness.

Among the well-to-do, it is not unusual to find chronic invalids who are physically sound except for a weak heart, weak musculature, and general debility throughout. I recall an instance of a woman fifty years of age, who, for the previous thirty years, had been a chronic invalid surrounded by physicians and nurses. In the course of a routine examination by a group of specialists, I was consulted by them for diet advice. She was steadily losing weight, although continuously confined to bed. For a long time, she had been living on a daily ration of not more than 800 calories. When it was explained to her that this was an insufficient amount of food, she replied that it was all she needed or could take and that she was different from other women in this respect. We advised a basal rate determination and found that her daily bed-rest requirements were 1250 calories. This convinced her of the need for more food and she gradually increased her diet until she was taking 2500 calories daily. This resulted in a gain of fifteen pounds in weight in the course of two months, and, by gradually increasing her exercise, at the end of that time she was leading and enjoying a normally active life. Such patients are often wrongly diagnosed hypochondriacs and neurasthenics.

Undernutrition is also commonly due to the inability to digest an adequate amount of food, because of an impaired digestion. Some patients, even when under the most careful dietetic care, can be made to gain in weight only when kept continuously in bed, and sometimes even this bed rest, careful diet regime may fail. A knowledge of the digestive juices with simple corrective aids may enable some to assimilate a normal diet.

I much prefer to correct digestive errors than to limit diets or activities.

Saliva is the first digestive juice and contains an enzyme known as ptyalin which converts starch into sugar. This digestive process takes place for the most part in the upper part of the stomach before its content becomes acidulated. Our saliva would be much more active if our food were taken dry and mixed thoroughly in the process of mastication. We usually eat too fast, although Fletcherism is the other extreme. Because of modern methods of preparation, very little food is taken in the dry form. The chewing of gum after meals, a habit frowned on by many, seems to be a fairly effective way of furnishing saliva.

The gastric juice contains hydrochloric acid, pepsin and rennin. The acid softens the protein foods causing them to take up water, a physico-chemical principle known as hydration. Butchers hang their meats for certain periods of time during which natural acids develop which make the meat tender. Wild ducks shot on Sunday are usually kept until Thursday for the same reason. By the judicious use of vinegar in amounts too small to be tasted, a tough piece of meat or an old fowl may be made unusually tender. Sour milk or buttermilk is more easily digested than sweet milk. The pickle served with meat, the lemon served with fish or shellfish, and the vinegar with beans make such foods more easily digested. Many undernourished patients have a subnormal amount of acid in their stomachs and some secrete none at all. Physicians study stomach digestion by means of simple test meals. When no free acid is present in the stomach, serious indigestion often occurs. This is due in part to the fact that the protein foods are not properly softened and also that they pass out of the

stomach too rapidly. Under normal conditions, the stomach automatically forces the food into the small bowel in small amounts, according to the following mechanism. When the alkaline bile and pancreatic juice have been secreted in an amount sufficient to alkalinize the pylorus or lower opening of the stomach, the sphincter muscle relaxes and the stomach forces out a small amount of the partially digested food. The pylorus then closes and remains closed until this food is neutralized and more bile and pancreatic juice again cause the relaxation of the pylorus. Sometimes, as will be seen later, there is a deficiency in these intestinal juices, and the stomach will empty very slowly. When there is a subnormal amount of acid in the stomach, hydrochloric acid is often prescribed, but doses larger than 30 drops three times per day cannot usually be given, whereas the normal stomach secretes 900 drops per day. I believe that too much hydrochloric acid may lead to blood vessel disease associated with high blood pressure. For the past three years I have been using the sour fruit juices such as lemon and grapefruit juice, and even vinegar, when these are not available. I have the patients served one to two ounces of lemon juice or grapefruit juice with their meals and instruct them to dilute this with water, sweeten to taste with sugar, and drink one-third before the start of the meal and sip the remainder with the meal. Such patients usually find that buttermilk is an unusually good food under such circumstances. Artificial buttermilk may be made fresh in the home by the use of cultures. Many of my patients make an effective and palatable sour milk by the addition of the juice of one lemon to a glass of sweet milk. Many babies have a subnormal amount of acid in their stomachs and pediatricians generally are using sour

milk, buttermilk, lactic acid milk and even lemon juice milk with marked success.

The gastric juice may contain a subnormal amount of pepsin. Pepsin is usually present when free acid is present and sometimes when there is no free acid. When this enzyme is missing it is easily supplied. I use an acid-pepsin mixture containing two ounces each of pepsin and dry citric acid together with sufficient of a palatable vehicle to make an eight-ounce mixture and give a teaspoonful before each meal well diluted with water or fruit juice.

Rennin is rarely absent.

The most common symptom of a complete or partial lack of gastric juice is alternate attacks of constipation and diarrhea. Periods of freedom from diarrhea may very well be due to the ingestion of the sour fruits such as the grapefruit. Stomach analyses should always be made as the first step in diagnosis whenever a patient complains of attacks of diarrhea.

The bile contains lipase and bile salts which assist in the digestion of fats. I have never had a patient in whom I have felt there was an inadequate amount of bile being made, although sometimes when the common bile duct becomes plugged with a stone or mucus, the bile is absorbed into the system causing jaundice. Stools are then clay-colored due to a lack of bile pigment and contain large amounts of fat.

The pancreatic juice is the most important of all of our digestive juices. It contains the enzyme *amylase*, somewhat similar to ptyalin, which digests starches and converts all sugar into glucose, the enzyme *trypsin*, which digests protein, and the enzyme *lipase*, which together with the bile digests the fats. The normal pancreas secretes three pints of this all-important digestive

juice in twenty-four hours. Many of the habitually thin, undernourished patients do not apparently make enough of this digestive juice. This deficiency is much harder to prove than one in the stomach. Patients often complain of an abnormal amount of gas on the bowels, caused especially by the eating of sweets and starchy foods. The stools may be foamy, float on water and contain sugar. Inflammation of the bowels may occur because of abnormal bacterial growth. This condition is known as fermentative colitis. If the proteins are not digested well, the gas passed has an unusually fetid odor. The stools may contain large amounts of fat. We can learn much about the digestion of foods by the routine study of stools. Such examinations are more effectively made during a patient's hospital stay when known diets are being served.

Intestinal indigestion may be treated by the elimination of certain foods such as the sugars, starches, proteins or fats, but it is much better, where possible, to correct the error in digestion and feed a normally balanced diet. Pancreatin, the commercial name for an extract of the pancreas, contains all of the enzymes. It is easily made but is usually useless when given by mouth because it is destroyed in the normal stomach. Parke, Davis & Company have succeeded in making for me a pancreatin tablet covered with a harmless coating (called an enteric coating) which in most instances remains unchanged while the tablet is in the stomach, but which comes off in the alkaline media of the small bowel, where the unharmed enzymes may work.[8] This tablet is now available everywhere through the drug trade. I have found it very efficacious in most forms of intestinal indigestion. The present coating is a little too thick when the digestion is seriously impaired. Work on this

problem is being continued. When the stomach contains no free acid, the uncoated tablets may be used provided the food contains no free acid; that is, they can be used with bread and milk but not with a meal containing sour fruit juices. Gelatine capsules sealed with white shellac sometimes afford ample protection to the pancreatin when the stomach digestion is partially but not completely lost.

I believe that many conditions such as urticaria, hives, eczema, and food asthma are due to the absorption of incompletely digested protein. The protein molecule, as will be explained later, is very large, oftentimes 1000 times as large as the glucose molecule. The process of digestion consists of splitting the protein molecule into simpler forms, such as the proteoses, peptides and finally the amino acids. These amino acids are about the size of sugar. Whole protein is a poisonous substance, as are the proteoses and peptides, but the amino acids are nontoxic. I believe that in certain forms of indigestion these incompletely split protein products are absorbed from the alimentary tract causing sensitization. The exclusion of such proteins from the diet usually gives only temporary relief because the patient soon becomes sensitive to other proteins. I usually try out digestive help first.

Three years ago a mother brought her son aged five to me for a diet. The child had a very severe form of food asthma, with the associated difficulty in breathing, and malnutrition. He had been seen by the best asthma specialists in the United States. Complete cutaneous food tests had been made in Boston and marked improvement temporarily followed when the offending foods were eliminated from the diet. He soon became sensitive to other foods when followed another series of tests in New York. Still other foods were eliminated

from the diet again with temporary improvement. He was later tested in Colorado Springs and found to be sensitive to practically all foods. His mother told me that she was feeding him a general diet because she preferred having him alive with asthma than dead from starvation. As an experiment I gave her the then new enteric coated pancreatin tablets mentioned above which brought about immediate improvement and effected a cure in one month. A physician brought his wife to me with a very severe form of hives due to the eating of strawberries. She had purposely eaten the strawberries the night before so that I might see how they affected her. The next morning one eye was swollen shut and there were many large wheals over her body. I started her on these pancreatin tablets and two weeks later had a crucial test when she again ate strawberries without the recurrence of her hives.

One's nutritional condition can accurately be checked by the gain or loss in weight even if little is known about the caloric value of foods. If a patient who is underweight is not gaining, while at the same time enjoying a normal activity, it is conclusive evidence of disease or that he is not eating sufficient food, and if one who is overweight does not lose, it is likewise certain that he is still eating too much food, exercising too little, or both. The best available normal weight tables are given in the appendix, pages 132 and 133.

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CHAPTER VI

THE PROTEIN REQUIREMENTS OF THE BODY

The normal diet should contain an adequate amount of protein for activity and growth.

The proteins which are made up of the four elements, carbon, hydrogen, oxygen and nitrogen, are spoken of as the nitrogen-containing foods, as distinguished from the carbohydrates and fats which do not contain nitrogen but are made up of carbon, hydrogen and oxygen only.

Protein is present in greatest abundance in meats, fish, shell-fish, fowl, eggs, milk, cheese, nuts, cereals and such vegetables as peas and beans. Although some protein is found in all foods, the amount is very limited in the purer sugars, starches and fats. The proteins of animal origin are more efficacious than those from vegetable sources, since they more closely resemble the body protein. The following table gives the relative values of proteins from various sources, as determined by Thomas.[1]

Beef	104	Yeast	71
Cow's milk	100	Casein	70
Fish	95	Nutrose	69
Rice	88	Spinach	64
Cauliflower	84	Peas	56
Crab meat	79	Wheat flour	40
Cherry juice	79	Cornmeal	30
Potatoes	79		

The protein of beef ranks highest in the list, but, because it is an acid-producing food, as we have discussed before, and because it is more difficult of preparation

and digestion than milk, it cannot be used to the best advantage in special diets or in the dietaries of young children. Milk protein ranks slightly lower than that of beef, but natural milk can be placed above all other foods as a source of protein because of its many additional, valuable properties and advantages, such as its ease of preparation and digestion, mineral and vitamine content, alkalinity, well balanced carbohydrate, protein and fat content, cost as compared with other foods of the same caloric value and its universal availability. One quart of milk daily, containing approximately 35 grams of protein, or nearly one-half the amount needed either by a child or an adult, should be considered the ideal amount of milk for all, young and old. Milk is too frequently omitted from the dietary of adults, many of whom consider it as a food for children only. One objection to milk is that it does not contain sufficient iron, but this may be supplied from other sources.

Protein is constantly used up by physical activity and must be replaced. As children grow, and as children and adults add to their musculature, especially in athletic training, considerable protein tissue is added to the body. It is obvious, therefore, that adequate nitrogen-containing food is essential in all diets. This principle applies to every type of special diet, as well as to the normal diet.

The daily protein requirements of an adult are estimated at from 80 to 100 grams. Children frequently need an equal amount, due both to their growth requirements and to their strenuous activities.

The consumption of too little protein food constitutes a very common and vital diet error, as does also the consumption of too much. Many children are allowed insufficient protein, and many women, as a matter of

choice, use too little of this indispensable food. Many men, on the other hand, consume too much meat.

It is hard for parents to realize that the active, growing child usually needs as much protein as an adult. He is usually given protein food in proportion to size rather than in proportion to needs. Active children often crave meat, and Mendel of Yale has assured us that a child's appetite in this respect is an excellent guide to his protein requirements.

Women give up the habit of drinking milk, believing it to be a food for children only, and if, at the same time they eat too little meat, the dietary in respect to protein is seriously deficient. As a consequence, they have little endurance, become anemic and continually complain of feeling cold. These conditions are either disregarded or are accepted as characteristic of a woman's lot as the weaker member of the family, whereas the female of the human species, like the female of the animal kingdom, has a right to as full vitality as the male.

On the other hand, many men consume as high as from 200 to 300 grams of protein per day. In addition to a heavy meat or egg breakfast, for lunch some men will order a large steak (eight ounces to a pound), and again at dinner in the evening they will have an extra large serving of chicken or roast. The protein molecule is a comparatively large one, weighing about one thousand times as much as the sugar molecule. In the processes of digestion, this large unit is broken down with considerable effort into the amino acids which, in size, approximate the sugar molecules. Regardless of how much work it may be, as stated before, an adequate amount of protein must be metabolized to satisfy activity and growth requirements. Beyond that, however, all that is broken down is merely converted into sugar

and fat and the nitrogen is thrown away to be excreted by the kidneys. As a result of the extra work consequent upon such heavy meat diets, much damage is probably done. The liver which is largely concerned with the breaking down of the excess amino acids into sugar and fat and with the elimination of the nitrogen, is needlessly burdened. The blood is burdened with excessive nitrogen-end-products, such as urea and uric acid which may directly or indirectly cause damage to the blood vessels, especially the smaller ones. The kidneys are burdened with the excretion of these end-products and may be damaged also. These considerations, apart from the injurious effect of meat as an acid producing food, which we have discussed before, are a sufficient condemnation of the excessive use of protein.

During the World War, a peculiar disease, a type of dropsy which was known as war-edema, developed in such countries as Roumania, where the meat supply, including the milch cows, was taken for the armies. The peasants were forced to subsist largely upon turnips and sawdust bread, so that their protein supply was low and of a very inferior type. It was eventually found that the disease was due to protein starvation. The same type of edema could be readily produced in experimental animals by placing them on similar rations, and the condition could be alleviated when an adequate amount of protein was restored to the diets.

There are certain diseases, notably high blood pressure and nephritis, in which the kidneys are damaged and care must be taken to place as little burden upon them as possible. In such cases, a minimum amount of protein should be used, but care should be taken not to reduce the allowance too low. Two-thirds of a gram per kilogram of body weight per day, or from 40 to 50 grams

for the average person, is considered to be the minimum protein requirement. A type of edema, quite similar to war-edema, has been induced by inadvisedly giving a too limited amount of protein to patients with damaged kidneys.

If a normal, active man, woman or child is consuming daily the animal protein equivalent of one quart of milk, two eggs and one generous serving of meat, fish or fowl, then, from the other miscellaneous sources, such as cereals, vegetables and fruits, an adequate protein quota will be completed.

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CHAPTER VII

THE MINERAL REQUIREMENTS OF THE BODY

The normal diet should include an adequate amount of the mineral-containing foods.

Our knowledge of the mineral requirements of the body has been greatly enriched during the past few years, especially as the regulation of the alkaline balance of the body has become better understood. It is by no means complete, and only those minerals found in the largest quantities in the body will be discussed in this chapter. The order in which they are taken up is not intended to infer anything about their relative importance. Indeed, it would be difficult to state which minerals have the most important functions in the body.

Iron.—Iron is present in the body, chiefly in the form of the organic compound, hemoglobin. Hemoglobin gives the red color to the red blood cells. It has the property of absorbing oxygen from the air in the lungs and carrying it in the blood stream to the various parts of the body where it is needed for oxidation. In passing through the lungs, the dark red, or venous blood is changed, by the addition of oxygen, to the bright red, or arterial blood. The determination of the hemoglobin content of the blood is one of the most important, routine, laboratory procedures.

The iron compounds necessary to the production of new hemoglobin are provided in the foods, especially in the red meats, the yolks of eggs, the green, leafy vegetables such as cabbage, spinach and asparagus, the colored root vegetables such as carrots, and such fruits as grapes, raisins and apples. It is interesting to note that

the amount present in the yolks of eggs is proportional to the supply of green vegetables the fowls receive. An iron deficiency in the diet is very common and gives rise to a reduction of the hemoglobin content of the blood. Also, hemorrhage and disease may cause a loss or destruction of hemoglobin-containing, red blood cells. To make up the deficiency arising from these causes, inorganic or mineral iron is usually given, but experimental evidence indicates that very little of this is assimilated and that the natural foods are the best source of available iron.

The use of liver in the treatment of all forms of anemia is to me the outstanding food discovery of the year. Whipple,[1] working with experimentally produced anemia in dogs, found liver the most efficacious of all substances tried. Koessler[2] and Minot[3] and others are responsible for the use of liver in the treatment of pernicious anemia. Previous to their work, pernicious anemia was considered a disease of unknown cause and of almost surely fatal prognosis. In December, 1926, Minot had had a series of 90 cases without a single death. Liver is served to such patients three times a day, varying the processes of preparation to lessen the monotony of the diet. Patient make such rapid improvement on these diets that they willingly cooperate. Many cases are on record in which the red blood count has increased from one million to five million in the course of six weeks' treatment. Kidney, heart muscle, and red meats are also very efficacious but not equal to liver.

The Carbonates.—The carbonates, chiefly those of sodium, potassium, and magnesium, are concerned with the eliminiation of carbonic acid from the body. The action of all of the carbonates may be illustrated by that of sodium carbonate. There are two carbonates of so-

dium: (1) sodium carbonate, commonly known, in an impure form, as washing soda, and (2) sodium bicarbonate, or baking soda. When a specimen of blood is centrifuged, the red, hemoglobin-containing corpuscles fall to the bottom of the tube, leaving a milky white fluid above. This milky white fluid, made up largely of water salts and digested food substances, is known as the blood plasma. In it are found small amounts of sodium carbonate. When carbonic acid is added to sodium carbonate, the bicarbonate of soda is formed. The carbonic acid which results from the oxidation of food in the tissues throughout the body, unites with the sodium carbonate in the blood plasma to form sodium bicarbonate. This sodium bicarbonate is carried by the blood stream to the lungs, where, in the presence of a diminished carbonic acid tension, the carbonic acid is released to be exhaled as carbon dioxide and water, leaving the original sodium carbonate free to be carried by the blood stream back to the tissues for another load. The proper elimination of carbonic acid from the body in this manner is so vital that, should breathing be prevented for even a few minutes, death would result from acidosis.

A method for determining the carbonic-acid-carrying power of the blood has been devised by Van Slyke.[4] This is one of the most reliable methods of estimating the degree of an acidosis when one is present. According to Van Slyke, each cubic centimeter of normal blood plasma can carry from 0.55 to 0.75 of a cubic centimeter of carbon dioxide. In certain diseases, fixed or nonrespirable acids are formed. These combine with the carbonates but cannot be eliminated in the lungs, so that the carbonic-acid-carrying power of the blood is seriously reduced. This is especially well illustrated in the disease diabetes when a serious acidosis exists. The non-

respirable acetone bodies combine with the carbonates, cannot be eliminated in the lungs, and the approach of coma is due both to the accumulation of these nonrespirable acids and to the resultant impaired ability of the body to eliminate the carbonic acid produced.

The carbonates are found chiefly in the fruits and vegetables.

All over the world people are taking large amounts of soda because they have found out empirically that soda helps them. I tell my patients that they should always take soda in reasonable amounts when they know it will help them, but that if they must continually take soda their diets do not contain enough of the soda and soda-like compounds in the fruits and vegetables.

It seems to me that a lack of sufficient of these soda-like compounds forms one of the most serious diet errors in athletic training. Muscles are trained for endurance, the heart is trained to pump large amounts of blood, the lung capacity is increased for adequate breathing purposes, but little attention is paid to the actual chemistry of breathing. Training diets must contain ample amounts of these soda-like compounds. These diets must necessarily be high in caloric value with ample protein for the building of muscular tissue. The army and navy apparently solve their problem by the generous use of the highly alkaline bean. More beans should be used in all training diets. Some of the heretofore unexplained records made by the less civilized races and by vegetarians may very well be due to this factor in their diets.

The Phosphates.—The phosphates, especially those of sodium and potassium, are used by the kidneys in maintaining the proper degree of alkalinity of the body. The sodium phosphates may be used to illustrate the

chemical reaction that takes place. There is an alkaline disodium phosphate which contains two atoms of sodium and one atom of hydrogen, and an acid sodium phosphate with one atom of sodium and two atoms of hydrogen. When diets are too acid, the kidneys maintain the alkaline balance of the body by changing large quantities of whatever alkaline, disodium phosphate there is available into the acid sodium phosphate and sodium. They excrete the acid sodium phosphate and retain the sodium which is alkaline.

If by means of the x-ray the density of a dog's bones is recorded, and the dog is fed on a meat diet, which contains none of the alkaline phosphates, in a month's time the bones will show a definite thinning. He has used the alkaline phosphates of his own bones to counteract the tendency of his acid diet. This might very well be the cause of bone and tooth destruction in human beings.

The alkaline phosphates are present in abundance in the fruits and vegetables. The acid phosphates are found in meats and are the chief source of the acid-ash in them.

Calcium.—Calcium, in the forms of calcium phosphate and calcium carbonate, comprises approximately 90 per cent of the mineral content of the bones.

Milk is the best source of calcium. It is also found in available forms in vegetables. The cow obtains its calcium from the grasses, and thus, directly or indirectly, practically all of our calcium comes from vegetable matter. When a calf is born, its bones are soft, being composed chiefly of cartilage; accordingly, its mother's milk should contain the essential calcium for the proper development of the bones. The bones of a new-born babe, also, are soft and composed chiefly of

cartilage, and its mother's milk should contain adequate calcium for their proper development. In many instances, the human mother fails to take sufficient calcium in her food, when her bones will be sacrificed to a certain extent, in nature's attempt to supply sufficient calcium to her offspring. It is a popular saying, that for every child born, a tooth is lost by the mother. This is literally true when the mother's diet is deficient in calcium, and is due to the softening of her teeth from which calcium is taken for the child during the periods of gestation and nursing. From birth to the attainment of full stature, the net calcium requirements of the body average fully six pounds. For the calcium need alone, not less than one quart of milk should be included in the daily ration of the growing child, and the nursing mother should have two quarts of milk in her diet, one for herself and one for her nursing babe. When full stature is reached, a pint of milk per day is apparently necessary to preserve the bones and teeth and I advise a second pint of milk in place of so much meat. I advise the use of one quart of milk per day for all, young and old.

Rickets, a serious disease of childhood, is due in part to a lack of calcium. Either the child does not receive sufficient milk, or the milk available, even if it is the mother's, is deficient in this indispensable mineral element. In consequence, the bones do not devolop as they should and the child acquires those deformities which are characteristic of the disease. The more recent researches attribute rickets to a combination of three factors:[5] (1) a lack of sufficient calcium phosphate; (2) a lack of sufficient of the antirachitic vitamine which will be discussed later, and (3) a lack of sunshine. Rickets is especially prevalent in the slums of large cities, where

the tall buildings and poorly lighted tenement houses preclude the sunlight, and where, because of poverty, neither the mothers nor the children can obtain a sufficient supply of good milk.

It is believed by some that the short stature of the native Japanese is due largely to a lack of sufficient milk in the national dietary. In such a congested country, there is little room for dairy herds. There is often a striking contrast in stature between parents born and reared in Japan, and their children who have been born and reared in an agricultural country like the United States. The latter often grow to be many inches taller than their fathers and mothers.

Calcium has other functions in the body which are not yet fully understood. It is essential to the proper clotting of blood, to the curdling of milk in the stomach, and to the functions of at least some of the digestive enzymes.

Sodium Chloride.—Common table salt, or sodium chloride, is another very important mineral in the body. It maintains the proper density of the body fluids and cells. It is split up in the stomach to form hydrochloric acid. It must have other functions. If distilled water be injected by vein, in a short time the urine will have a smoky or red color, due to destruction of the red cells of the blood. The distilled water, having the lower density, is rapidly absorbed by the red blood cells, so that they swell up and burst. Salt solutions in which red blood cells will neither swell nor shrink, are said to be isotonic with the blood and are called normal or physiologic salt solutions. When such solutions are injected by vein, no damage is caused to the blood corpuscles.

Although the average needs of the body do not exceed 2 grams of sodium chloride daily, by the voluntary addi-

tion of salt as a seasoning, most individuals take about 15 or 16 grams. This is daily excreted in the urine. Carnivorous, or flesh-eating, animals obtain ample sodium chloride from the flesh and blood of the animals eaten and do not crave additional salt. Herbivorous, or plant-eating animals do not receive sufficient sodium chloride from vegetation alone, and, if necessary, will travel hundreds of miles to a salt-lick or to salt springs, as hunters of wild game appreciate. The farmer knows that his domestic animals do not thrive unless properly "salted." Some countries, Italy for example, take advantage of the universal need of animal life for a sufficient supply of sodium chloride and derive substantial revenues from its taxation.

In certain diseases, notably high blood pressure associated with serious kidney damage, it is sometimes necessary to limit the sodium chloride intake to the minimum needs of the body, two or three grams per day, but where kidney function is good such strict limitations are not necessary. Such patients, however, should certainly be warned against the excessive use of salt.

Iodine.—Iodine, although required in but small amounts in the body, is nevertheless essential. It is used in the elaboration of the internal secretion of the thyroid gland. When a sufficient supply is not available, an enlargement of the thyroid gland results. The enlarged neck, so often seen in the adolescent period, is usually due to an abnormal development of this gland, apparently in order that it may utilize to the utmost a too scanty supply of iodine.

Drinking water has heretofore been recognized as the chief source of iodine to which may now be added the green vegetables. There are certain districts in the world, notably Switzerland, the territory surrounding

the Great Lakes and the Puget Sound region, where the water is deficient in this mineral element. I am well acquainted with the conditions in the region of the Great Lakes where even the dogs have enlarged thyroid glands. Some very careful and instructive work has been done by Marine and Kimball[6] on the children in the city schools of Akron, Ohio, where the effect of this iodine deficiency has been carefully estimated and successfully treated. The remedy is surprisingly simple. The prophylactic administration of 2 grams, 30 grains, of sodium iodide twice yearly prevents the thyroid enlargement and causes a marked decrease in the size of those already enlarged. The use of iodized salt is becoming more and more general in districts where there is an iodine deficiency. Patients who already have toxic goiters are, according to Hartsock[7] sometimes made worse by the injudicious use of iodine-containing salts, so that some caution must be taken in instructing patients.

We have a peculiar situation in Southern California which is well outside the goiter districts, for the well waters contain from 6000 to 8000 parts of iodine per 100,000,000,000 parts of water when twenty-three parts are sufficient to prevent the development of this type of goiter. In a recent survey of the school children in Santa Barbara, Lamb[8] found 11 per cent with definite evidences of goiter. This is due to the fact that with the increasing population, this city, as many other cities, is dependent upon rain water impounded in large reservoirs for its water supply. Despite the fact that an occasional adult toxic goiter may be made worse, I am advising the more general use of iodine-containing salt where surface water is used.

Sulphur.—Sulphur is a constituent of such tissues as hair and nails. It is available from the yolks of eggs, onions, and from the cabbage family. The total amount in the human body is small and undoubtedly deficiencies are rare. I recall an instance in which a sulphur deficiency may have existed. A child afflicted with an extremely severe degree of diabetes had, for a long time, necessarily been taking an exceedingly low diet. Her fingernails were thin and her hair was fine, brittle, and flaxen in color. When insulin made an adequate diet possible, her hair changed to a dark brown color and grew very rapidly, while her nails became firm.

If an individual has a normal hemoglobin, if an adequate amount of fruits and vegetables are taken to satisfy the bulk and alkali requirements of the body and if the diet contains one quart of milk daily, it is reasonably certain, save in those districts where the water is deficient in iodine, that the mineral needs of the body will be fully satisfied.

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CHAPTER VIII

THE VITAMINE REQUIREMENTS OF THE BODY

The normal diet should contain an adequate amount of the vitamines.

The vitamines*[1] are substances of unknown composition which exist in minute quantities in the natural foods and are necessary to normal nutrition and growth. Their absence from the diet is responsible for such deficiency diseases as xerophthalmia, beriberi, scurvy, rickets and sterility. Vitamine diseases are the direct result of artificially limited diets due to concentration in population and illustrate emphatically the need for variety in diet. The properties of five, A, B, C, D, and E, have been definitely described. There are doubtless others.

A. The fat-soluble vitamine A is found most abundantly in butter fat, egg yolks, glandular organs, cod-liver oil (especially the crude cod-liver oil which is 250 times as valuable in this respect as the refined cod-liver oil), tomato juice, and in the green leafy plants. Lard and most vegetable fats are nearly devoid of it. The absence of this vitamine from the diet gives rise to the disease xerophthalmia or dry-eye. In 1904, Mori in Japan described well over 1000 cases in children at the time of the great food shortage. The condition was cured by the feeding of chicken livers. During the World War an epidemic of this disease in children occurred in Denmark and was due to the fact that prac-

*For an exhaustive history, discussion and bibliography of the subject of vitamines, the reader is referred to "The Newer Knowledge of Nutrition" by McCollum, E. V., and Simmonds, Nina, The Macmillan Company, 1925.

tically all of the butter fat was shipped to Germany. A health order was issued to the effect that all children should have at least one-sixth of an ounce of butter fat per day. Xerophthalmia may be produced readily in experimental animals such as the rat. When this vitamine is excluded from the diet they cease to thrive and become highly susceptible to bacteria. The eye symptoms commence with a dryness of the conjunctiva and a swelling of the lids and later develop into a purulent inflammation which often leads to ulceration and blindness. The administration of a very small amount of vitamine A causes a rapid dissipation of the disease. I recall having prepared a rat for the purpose of demonstrating this disease to a medical clinic. On a Saturday afternoon the rat had xerophthalmia and was in imminent danger of losing one eye. As this class did not meet until the following Tuesday, a teaspoonful of cream was given, only to find that when Tuesday arrived all symptoms of the disease had disappeared.

B. The water-soluble vitamine B is found in greatest abundance in the germs of seeds, the leaves of plants and yeast. It is the most interesting of the group and has so many properties that there may very well be more than one vitamine included under this heading. A deficiency in this vitamine is very common. A lack of this vitamine results in (1) multiple neuritis or beriberi, which is frequently followed by paralysis; (2) loss of appetite; (3) failure in growth; and (4) changes in the ovulation rhythm.

Beriberi, endemic in Japan, quickly became a menace with the establishment of the navy in 1862. From one-fourth to one-half of the entire personnel was continuously disabled with this disease. Their diet consisted of meat and polished rice. In 1897 Eijkman, a Dutch

physician to a prison hospital in Java, accidentally discovered this disease in all of the chickens in his coops. The birds were fed left-over, cooked, polished rice from the hospital kitchen. When unpolished rice was fed, prompt recovery occurred. He then produced the disease with polished rice and corrected it with unpolished rice or the polishings. He was able to produce this disease in prisoners by the feeding of polished rice, completely curing it by the feeding of the crude rice. He also determined that wheat germ, rye, barley and potatoes protected against this disease. During the epidemic in the Japanese navy, Takaki, believing that the disease might be due to a lack of protein, substituted barley for a part of the rice with almost complete eradication of the disease. The army did not do this. During the Russo-Japanese war in 1905 there was no case of beriberi in the navy, but there were 200,000 in the army. The navy ration consisted of 16 ounces of meat, 10 ounces of barley and 20 ounces of rice. The army ration consisted of 50 ounces of meat and 30 ounces of rice.

Cowgill[2] has shown that vitamine B prepared from yeast contains an appetite-producing substance. Feeding experiments in which only concentrated, purified foods are given usually fail because after the first few days of such a monotonous diet, the animals refuse to eat. Cowgill found that when a very small amount of vitamine B was added, the animals resumed eating the same monotonous diet with apparent relish. The addition of an adequate amount of fresh, green vegetables to the diet, whether in children or adults, always results in better appetites. The great value derived from the widely advertised yeast cake must be largely due to this principle, the lack of which is one of our most common deficiencies.

Osborne and Mendel proved that vitamine B contained a growth-producing principle and Evans and Bishop demonstrated that the ovulation rhythm is an especially sensitive indicator of the same deficiency.

C. Water-Soluble C is found abundantly in lemons, oranges, grapefruit, tomatoes, potatoes, green vegetables and the germs of seeds. Its absence from the diet gives rise to scurvy, a constitutional disease characterized by great weakness, anemia, a spongy condition of the gums and a marked tendency to hemorrhages. Its seriousness was first realized when long voyages were undertaken. Vasco de Gama achieved his pioneer voyage around the Cape of Good Hope to the West Indies at a cost of one hundred deaths from scurvy out of a crew of one hundred sixty men. On April 2, 1600, four ships left England on an expedition to establish the East India Company. Scurvy occurred to so great an extent that in three of the four ships one-fourth of the men died before reaching the Cape and the rest were in a miserable condition. All of those on the fourth vessel, the Commodore's ship, were in perfect health as a result of the order that each man should consume three tablespoons of lemon juice daily. Eventually, the order was established that every British seaman take lemon juice. Later, scurvy again became prevalent in the British navy due to the substitution of East India lime juice for lemon juice. While lemons and oranges are very high in vitamine C, limes are singularly low. An excellent description of scurvy may be found in Dana's *Two Years before the Mast.* His ship was blown out to sea during their return trip from the California coast, thus prolonging the voyage and depleting their supplies. As they neared the Bermuda Islands they met a ship car-

rying provisions and obtained from them onions and potatoes which quickly cured the disease.

Scurvy, like the other deficiency diseases, can be produced readily in experimental animals and it is promptly cured by the addition of citrus fruits to the diet. In a mild form, it is a fairly common ailment in babies in whom it may be prevented or cured by giving small amounts of orange or tomato juice, a custom which has become so common during the past few years that it is no longer considered unusual.

D. Fat-soluble vitamine D is found in conjunction with vitamine A and until recently was thought to be identical with it. McCollum separated vitamine D from vitamine A. He found that cod-liver oil treated with a stream of air at 100 degrees centigrade, 212 degrees Fahrenheit, for twenty hours, no longer contained sufficient of vitamine A to cure rats of xerophthalmia when given as 2 per cent of the diet, although it had lost no appreciable part of its potency in the prevention or cure of rickets.

A lack of vitamine D is in part responsible for rickets, a disease which is characterized by maldevelopment of bony tissue and is especially prevalent in the slums of large cities. The incidence of rickets is due to a deficiency in (1) vitamine D, (2) the mineral calcium, and (3) sunshine. All of these essentials are lacking to the children brought up in the poorly lighted tenements or narrow, dark alleys, to whom an adequate supply of milk is seldom available. The lack of milk deprives them of the antirachitic vitamine and calcium, while such quarters shut out the sunshine. However, this disease is not entirely confined to the poor but is sometimes found in the families of the well-to-do where nursing

mothers fail to eat properly balanced diets. Recent studies indicate that children may be born with rickets due to deficiencies in the diet of expectant mothers.

E. Fat-soluble vitamine E was first discovered by Evans and Bishop in 1922. They showed that a diet consisting of casein, cornstarch, lard and salts with yeast and cod-liver oil for vitamines A and D caused rats to be nonfertile due to a disease which affected the placenta. The disease was cured by the administration of certain natural foodstuffs, lettuce and wheat germ being the most potent. They later reported the production of sterility in the male from testicular degeneration by pure diets and its cure with the same foodstuffs as used in the female. Their observations have been already confirmed by other workers.

Vitamines A, B, D and E survive high temperatures, but C is destroyed by boiling in the presence of oxygen. C is not destroyed if heated in the absence of oxygen as in sealed cans. Fortunately, the citrus fruits keep well and are usually served raw.

With the present tendency away from the consumption of an adequate amount of fruits, vegetables and milk, the need for vitamines must be taken into consideration in the planning of all diets.

References

[1]McCollum, E. V., and Simmonds, Nina: The Newer Knowledge of Nutrition, 1925, The Macmillan Company.
[2]Cowgill, G. R.: Jour. Biol. Chem., 1925, lvi, 725.

CHAPTER IX

THE WATER REQUIREMENTS OF THE BODY

The normal diet should contain an adequate amount of fluids.

Water has at least three important functions in the body: (1) it is an excellent food solvent; (2) it is indispensable as a sewage fluid; (3) it is an important factor in the regulation of body temperature.

1. **A Food Solvent.**—Many foods are naturally soluble in water, and those which are not are rendered so in the processes of digestion. All require an adequate amount of water for their proper absorption in solution. The amount of liquid that should be taken with meals has been a debatable subject, some advising as little as possible and others a considerable amount. All agree that food should be properly masticated and not merely washed down. At least, the drinking of plenty of liquid following heavy meals, such as elaborate banquets and Thanksgiving and Christmas dinners, materially aids in their digestion and absorption. Ice cold drinks delay digestion until they are warmed to body temperature.

2. **A Sewage Fluid.**—The nitrogen-containing end-products of metabolism, as well as the ash of the burned foods, are soluble in water and are eliminated in solution in the urine, and, to a minor extent, in the perspiration. When an insufficient amount of liquid is taken, the urine may be too concentrated to permit of the adequate elimination of these end-products.

3. **A Factor in the Regulation of Body Temperature.**—The rôle of water in the regulation of the body tem-

perature is one of the problems which is at present receiving considerable attention in medical research work. For a long time, it was believed that somewhere in the brain there was a heat-regulatory center, or thermostat, but such a center has never been located. There is increasing evidence that the maintenance of a normal body temperature, in health and disease, is largely concerned with an adequate supply of water.

In a previous chapter we have discussed the production of heat in the body from food. Under normal conditions, the body maintains a fairly constant temperature, so that its heat elimination is equal to its heat production. Heat is lost from the body mainly in two ways: (1) by contact and (2) by the vaporization of water.

1. **By Contact.**—Heat is lost from the body when it comes in contact with substances cooler than itself, such as the clothing and the inspired air. Under usual conditions of very moderate activity about 75 per cent of the heat is lost from the body in this manner.

2. **By the Vaporization of Water.**—The body loses heat, as latent heat, by the vaporization of water. This is the most flexible manner of losing heat for it requires a large amount of heat to change water into water vapor. Whereas it requires but 100 calories of heat to raise a unit-volume of water from the freezing to the boiling point, it requires 537 calories to change the same unit-volume of water, at the boiling point, into steam or water vapor. Because steam has the same temperature as boiling water, this heat which seems to disappear in the change, is known as latent or hidden heat. The principle here involved is used in the heating of houses by steam. The steam generated in the boiler rises, with

this great load of latent heat, to the various radiators in the house, where, as it cools and changes back to water, it gives up this large amount of heat to the rooms. The body changes water to water vapor at the body temperature, and, in so doing, gives up approximately the same large amount of heat. The air which is breathed out is saturated with water vapor, and, as the activities are increased, with a consequent increase in the number and volume of respirations, still more water vapor with its latent heat is lost from the body.

In the same manner, heat is lost from the body by the vaporization of perspiration. At all times, even when no perspiration is visible to the eye, a considerable amount is given off in the form of water vapor with its latent heat. If a person perspires profusely, especially when there is a breeze, which increases the rapidity of vaporization, there is always danger of cooling the body too rapidly. It is to prevent such a rapid loss of heat that the pitcher of a baseball team, even on the hottest summer day, puts on a heavy sweater at the close of an inning, that football players are promptly covered with thick, woolen blankets or sweaters between playing periods, and that, following a horse race, the attendants promptly cover the sweating horse with blankets.

By means of a respiratory calorimeter, the amount of heat lost from the body in vapor can be accurately measured. Experiments have shown that, in heightened metabolism caused by exercise, as high as 47.6 per cent of the total heat dissipated from the body may be lost in this manner.[1] Keeton[2] has recently shown that if the temperature of the surrounding air is as high as that of the body, and consequently no heat can be lost by

contact, then all of the heat is lost by the vaporization of water.

The need of copious amounts of water while strenuous work is being done, is a matter of common experience. The constant stream of laborers to the water-pail, especially in hot weather, is not, as is often erroneously supposed, an excuse to loaf. Men who do manual labor such as the building and maintaining of railroads in our desert sections are allowed one quart of water each hour. When one is mountain climbing on warm days, the imperative need of the water-canteen is experienced. The same principle, with respect to the automobile, is illustrated by the necessity of frequently filling up the radiator, especially while mountain-driving or crossing a desert country.

The rate at which heat is lost from the body by the vaporization of water depends, not only upon the amount of heat produced within the body, but also upon external factors which influence vaporization, among which is the relative humidity of the atmosphere. The expression, relative humidity, is familiar to readers of the weather reports. The warmer the air, the more water vapor it can contain. Its relative humidity is the percentage of water vapor it contains at a given temperature as compared with its saturation point at the same temperature. Thus, if the relative humidity of the air in a desert region, at a temperature of 130° F., is 1 per cent, this means that it contains 1 per cent as much moisture as it can contain at this temperature. A relative humidity of 96 per cent on a hot, sultry day with a temperature of 100° F., means that the air contains 96 per cent as much moisture as it can contain at this temperature. When the relative humidity is high, the

loss of heat from the body by the vaporization of water is seriously interfered with.

I vividly recall the occurrence of a 96 per cent relative humidity at a temperature of 100° F., in one of our large inland cities, when, in the course of some experiments, I was learning to make relative humidity determinations. Beads of perspiration stood out on all the exposed surfaces of the body, the clothing became wet, starched collars were wilted quickly, teamsters refused to take their horses out of the barns, laborers were unable to continue work and many people died from heat stroke. I have personally been much more uncomfortable at a temperature of 100° F., with a relative humidity of 96 per cent than I have been at a temperature of 130° F., with a relative humidity of 1 per cent. In the light of what has been said concerning the loss of heat from the body, such discomfort and heat strokes will be readily understood. With the temperature of the air equal to that of the body, practically no heat can be lost by contact, while a relative humidity of 96 per cent permits of very little being lost by the vaporization of water. Under such circumstances, those who cannot reach a cooler or less humid environment, find it necessary, in order to avoid serious consequences, to limit heat production, by eating sparingly and by refraining from all unnecessary exertion. Ice cream, which is sold in large amounts during the hot weather, is an unusually poor hot weather food because of its high fat content. Sherbets and iced fruit juice drinks are very much more efficacious.

I[3, 4] believe that in those diseases characterized by an elevation of body temperature, the toxins produced cause the cells of the body to bind water so firmly that

the loss of heat by the vaporization of water is interfered with. As a result, the heat loss becomes less than the heat produced, and the elevation of temperature follows. The cause of this abnormal binding of water in febrile diseases is not fully understood, but that it does occur is very apparent. In the early stages of a typical case of pneumonia, for example, the patient complains of thirst, the urine is scanty and of high specific gravity, there is little or no visible perspiration and there is a rapid gain in weight. When the crisis comes, the thirst disappears, many liters of straw-colored urine are passed, the patient perspires profusely, the weight falls rapidly and the fever subsides.

It seems logical to supply febrile patients with copious amounts of fluid. Many physicians used large amounts of fluid during the two great influenza epidemics. Sufficient fluid, usually in the form of fruit juice mixtures, was given to keep the urine straw-colored and of low specific gravity. This often required as much as eight quarts or more of fluid per day. Excellent clinical results followed. In two series of influenza cases during the two great epidemics I, personally, had no deaths following such treatment. When the cases were seen at the onset, the fever never became alarmingly high and rarely lasted longer than twenty-four to thirty-six hours. The periods of convalescence were short. In cases seen some time after onset with temperature as high as 105° F. or 106° F., and usually with bronchial-pneumonia, such fevers were reduced in the course of a few hours to safer levels ranging from 99° F. to 102° F. and maintained at such levels throughout the course of the disease.

It is a matter of general observation that patients

afflicted with tuberculosis are better at the higher, drier altitudes, and, upon the principles stated, it is reasonable to assume that this is due, in part at least, to the lower relative humidity prevalent in such localities.

I believe that the toxemia associated with febrile diseases, is due, not only to the original toxins of the infection, but also to the injury and death of cells throughout the body caused by the fever, and that, for this reason, every elevation in fever should be avoided if possible.

As stated before, the basal metabolic rate increases approximately 7 per cent with each degree Fahrenheit above normal temperature, and thus we have another of the vicious circles so common in disease: the higher the temperature, the greater the need for adequate means of losing heat from the body, while, the greater the toxemia ,the less water there is available to cool the body by vaporization.

Discussions have arisen in the last few years concerning the value of alcohol in the treatment of febrile diseases. Many physicians staunchly maintain that copious amounts of dilute alcohol, popularly known as "whiskey slings," have a beneficial effect in lowering temperature. However, alcohol certainly binds water in the body, as evidenced by the thirst which develops, especially when the concentrated liquors are used. This deleterious effect is probably counteracted by the water when liquors are well diluted, so that the net result may be good. It frequently happens that patients who have a craving for alcohol will drink large amounts of water if it is flavored with this popular drug, when they would otherwise fail to do so, but in my own experience, the citrus fruit juices well diluted with water have no deleterious effects

and have proved more efficacious in the dissipation of temperature.

The measuring of a twenty-four-hour specimen of urine is a very simple method of determining whether or not sufficient water is being taken to carry on the body functions. The normal urine should be of a light straw color and should total in the neighborhood of three or four pints a day.

References

[1]Benedict, F. G., and Carpenter, T. M.: Carnegie Institution of Washington, 1910, Pub. 126.
[2]Keeton, R. W.: Am. Jour. Physiol., 1924, lxix, 307.
[3]Balcar, J. O., Sansum, W. D., and Woodyatt, R. T.: Arch. Int. Med., 1919, xxiv, 116.
[4]Sansum, W. D., and Schmitt, E. C.: California State Jour. Med., 1921, xix, 371.

APPENDIX

THE TESTING OF URINE FOR ACIDITY

There is an excellent book entitled *The Determinations of Hydrogen Ions* by Williams Mansfield Clark, published by the Williams and Wilkins Company, Baltimore. This book contains full details on hydrogen-ion determinations together with color plates. Reprints of the color plates may be secured separate from the book. For the convenience of my patients I have typewritten on the Methyl Red and Brom Thymol Blue color plates the interpretation of the logarithmic expressions in urine acidity times that of normal blood, and I furnish them with inexpensive outfits for home use.

An Interpretation of Such Expressions as: The Normal Hydrogen-Ion Concentration of the Blood Is P_H 7:35.

A simple teaching interpretation of the logarithmic method of expressing the hydrogen-ion concentration (H) follows: The hydrogen-ion concentration of the normal blood is equal to the decimal fraction 0.0000000-4467. This is less than the hydrogen-ion concentration of distilled water, which is equal to the decimal fraction 0.0000001. Distilled water is neutral in its reaction. The blood, having a lower hydrogen-ion concentration than distilled water, is therefore slightly alkaline. The writing of such decimal fractions consumes both time and space; hence the logarithms representing such fractions are used instead. The logarithms are always minus; hence the minus sign is dropped. The normal hydrogen-ion concentration of the blood is written P_H 7.35, which, interpreted, means that the potential of the

hydrogen-ion concentration of the blood is equivalent to a decimal fraction corresponding to the logarithm –7.3500.

A still simpler method of making the hydrogen-ion concentration expressions of urine acidity understandable to patients is to express such acidities not in logarithms but in the number of times that the urine is more acid than normal blood, as in the following table:

URINE P_H	ACIDITY TIMES THAT OF NORMAL BLOOD	URINE P_H	ACIDITY TIMES THAT OF NORMAL BLOOD
7.35	1.	5.80	35.4
7.30	1.1	5.70	44.6
7.20	1.4	5.60	56.2
7.10	1.7	5.50	70.8
7.00	2.2	5.40	89.1
6.90	2.8	5.30	112.2
6.80	3.5	5.20	141.3
6.70	4.4	5.10	177.8
6.60	5.6	5.00	223.8
6.50	7.0	4.90	281.8
6.40	8.9	4.80	354.8
6.30	11.2	4.70	446.7
6.20	14.1	4.60	562.3
6.10	17.7	4.50	708.0
6.00	22.3	4.40	891.2
5.90	28.1	4.35	1000.0

The reaction of the urine may easily be determined by means of dyes which are called indicators. Pieces of paper dipped in the dye, litmus, have been used for this purpose for a long time. This dye has the property of turning red in an acid solution and blue in an alkaline solution. The dye, litmus, however, is not a very delicate indicator, in fact I believe that a urine which is acid enough to turn blue litmus paper to red is far too acid

and a urine which is alkaline enough to change red litmus paper to blue is probably too alkaline. More delicate dyes, Brom Thymol Blue and Methyl Red, have therefore been chosen.

The dyes chosen have the advantage of changing to several colors depending upon the degree of acidity or alkalinity. The dye, Brom Thymol Blue (B. T. B.), is yellow in a slightly acid solution and blue in a slightly alkaline solution. As the reaction changes from acid to alkaline, the color changes gradually from a yellow-green to a green, to a blue-green and finally to a blue. The dye, Methyl Red (M. R.), is used in the more acid urines. In the extremely acid urines it is red, and in the moderately acid urines it is yellow with varying shades of color between.

The material used for the test:

1. Large test tubes.
2. 2 dyes in dropping bottles. Brom Thymol Blue (0.04 per cent) for the less acid urines and Methyl Red (0.02 per cent) for the very acid urines.
3. Color chart.
4. Medicine dropper.
5. Distilled water.
6. A specimen of urine to be tested. This should be a part of a twenty-four-hour specimen but single specimens may also be tested.

A medicine dropper full of urine (it need not be measured accurately because the dye expresses the ratios between the alkaline and acid components of the urine rather than the total amount of either), should be placed in a test tube, and for the first test, 10 drops of Brom Thymol Blue are added with enough distilled water to

nearly fill the test tube. It should then be thoroughly shaken. The shade of color should then be compared with the Brom Thymol Blue color plates in daylight against a white background. The green-blue shade with the typewritten figures 2.2 (P_H 7.0), is, I believe, the ideal shade but the shades marked 3.5 (P_H 6.8), and 5.6 (P_H 6.6), do not indicate very acid urines. If with this indicator, the shade is yellow, another test tube should be used as before except that five drops of Methyl Red should be added and the shade compared with the Methyl Red color plates. None of these degrees of acidity are satisfactory but they express the net result of the ash of the diet and should warn patients to change their diets radically toward the alkaline side.

HEIGHT AND WEIGHT TABLES

The following tables have been selected from various sources and seem to be the best, simple ones obtainable. The weights for adults should be considered as maximum. Where individuals have a small, bony framework, five to ten per cent might very well be deducted from these tables.

Heights and Weights of Children Between One and Four Years of Age (Without Clothes)

5602 boys			4821 girls	
Height, inches.	Weight, pounds.	Age, months.	Height, inches.	Weight, pounds.
26.5	18.0	6	25.9	16.8
27.3	19.1	7	26.5	17.4
27.6	19.8	8	27.0	18.3
28.1	20.4	9	27.6	19.1
28.5	20.9	10	27.9	19.5
29.0	21.4	11	28.4	20.1
29.4	21.9	12	28.9	20.8
29.9	22.9	13	29.4	21.0
30.3	23.0	14	29.5	21.6
30.8	23.6	15	30.1	21.9
31.1	24.1	16	30.5	22.6
31.4	24.5	17	30.8	22.9
31.8	24.6	18	31.1	23.4
32.3	25.5	19	31.5	23.8
32.6	25.8	20	32.0	24.1
32.9	25.8	21	32.3	24.8
33.3	26.9	22	32.6	25.3
33.6	27.0	23	32.9	25.6
33.8	27.1	24	33.4	26.4
34.0	27.9	25	33.8	26.9
34.1	28.3	26	33.9	27.3
34.8	29.0	27	33.9	27.3
35.1	29.1	28	34.6	27.8
35.4	29.3	29	34.8	27.8
35.4	29.5	30	34.9	28.3
35.5	30.5	31	35.1	28.8
36.0	30.6	32	35.4	29.0
36.1	30.6	33	35.6	29.1
36.5	31.1	34	36.5	30.1
36.8	31.9	35	36.5	30.3
37.1	32.3	36	36.8	30.5
37.4	32.3	37	36.8	30.8
37.5	32.4	38	37.0	31.0
37.9	33.1	39	37.3	31.6
38.5	33.5	40	37.5	32.0
38.6	33.6	41	37.8	32.3
38.6	33.8	42	38.0	32.5
38.8	33.8	43	38.3	32.8
38.9	34.3	44	38.5	33.0
39.0	34.5	45	38.5	33.5
39.0	34.8	46	38.8	33.5
39.3	35.8	47	38.9	33.5
39.5	35.9	48	39.0	33.8

Crum, F. S.: Quarterly Publication of the American Statistical Association, Boston, September, 1916, N. S., No. 115, xv, 332-336.

Heights and Weights of Girls Between Five to Fourteen Years (Without Clothes).

GIRLS

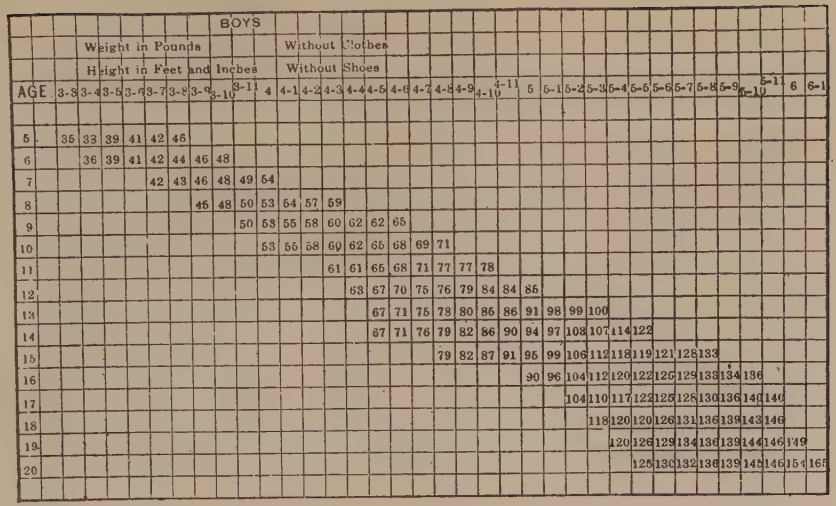
Weight in Pounds Without Clothes

Height in Feet and Inches Without Shoes

AGE	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	4	4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	5	5-1	5-2	5-3	5-4	5-5
5		34	37	38	41	41	45																				
6			35	37	39	41	43	45	48																		
7					39	42	44	46	47	50																	
8							42	45	47	49	51	53	56														
9										49	51	53	56	59	63												
10												54	57	58	62	64	69										
11														60	62	63	68	70	75								
12															63	66	69	71	75	78	83	88	94				
13																65	68	73	76	80	86	89	94	99	104		
14																			78	83	88	93	96	100	104	107	112	114
15																					89	97	100	102	106	109	113	118
16																						100	104	108	111	116	116	121
17																							108	108	110	110	117	125
18																							103	106	107	112	114	120
19																							99	105	111	113	119	123
20																							99	111	114	114	116	126

Mutual Life Insurance Company.

Heights and Weights of Boys between Five to Fourteen Years (Without Clothes).



Metropolitan Life Insurance Company.

Heights and Weights of 221,819 Men of Fifteen or More Years of Age (With Clothes).

	Graded average weight in pounds with clothes.																	
	Feet and inches with shoes																	
Age	5–0	5–1	5–2	5–3	5–4	5–5	5–6	5–7	5–8	5–9	5–10	5–11	6–0	6–1	6–2	6–3	6–4	6–5
15	107	109	112	115	118	122	126	130	134	138	142	147	152	157	162	167	172	177
16	109	111	114	117	120	124	128	132	136	140	144	149	154	159	164	169	174	179
17	111	113	116	119	122	126	130	134	138	142	146	151	156	161	166	171	176	181
18	113	115	118	121	124	128	132	136	140	144	148	153	158	163	168	173	178	183
19	115	117	120	123	126	130	134	138	142	146	150	155	160	165	170	175	180	185
20	117	119	122	125	128	132	136	140	144	148	152	156	161	166	171	176	181	186
21	118	120	123	126	130	134	138	141	145	149	153	157	162	167	172	177	182	187
22	119	121	124	127	131	135	139	142	146	150	154	158	163	168	173	178	183	188
23	120	122	125	128	132	136	140	143	147	151	155	159	164	169	175	180	185	190
24	121	123	126	129	133	137	141	144	148	152	156	160	165	171	177	182	187	192
25	122	124	126	129	133	137	141	145	149	153	157	162	167	173	179	184	189	194
26	123	125	127	130	134	138	142	146	150	154	158	163	168	174	180	186	191	196
27	124	126	128	131	134	138	142	146	150	154	158	163	169	175	181	187	192	197
28	125	127	129	132	135	139	143	147	151	155	159	164	170	176	182	188	193	198
29	126	128	130	133	136	140	144	148	152	156	160	165	171	177	183	189	194	199
30	126	128	130	133	136	140	144	148	152	156	161	166	172	178	184	190	196	201
31	127	129	131	134	137	141	145	149	153	157	162	167	173	179	185	191	197	202
32	127	129	131	134	137	141	145	149	154	158	163	168	174	180	186	192	198	203
33	127	129	131	134	137	141	145	149	154	159	164	169	175	181	187	193	199	204
34	128	130	132	135	138	142	146	150	155	160	165	170	176	182	188	194	200	206
35	128	130	132	135	138	142	146	150	155	160	165	170	176	182	189	195	201	207
36	129	131	133	136	139	143	147	151	156	161	166	171	177	183	190	196	202	208
37	129	131	133	136	140	144	148	152	157	162	167	172	178	184	191	197	203	209
38	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	198	204	210
39	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	199	205	211
40	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	206	212
41	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	207	213
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52	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
53	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
54	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219
55	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219

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Heights and Weights of 136,504 Women of Fifteen or More Years of Age (With Clothes)

Age	Graded average weight in pounds with clothes. Feet and inches with shoes																
	4-8	4-9	4-10	4-11	5-0	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	6-0
15	101	103	105	106	107	109	112	115	118	122	126	130	134	138	142	147	152
16	102	104	106	108	109	111	114	117	120	124	128	132	136	139	143	148	153
17	103	105	107	109	111	113	116	119	122	125	129	133	137	140	144	149	154
18	104	106	108	110	112	114	117	120	123	126	130	134	138	141	145	150	155
19	105	107	109	111	113	115	118	121	124	127	131	135	139	142	146	151	155
20	106	108	110	112	114	116	119	122	125	128	132	136	140	143	147	151	156
21	107	109	111	113	115	117	120	123	126	129	133	137	141	144	148	152	156
22	107	109	111	113	115	117	120	123	126	129	133	137	141	145	149	153	157
23	108	110	112	114	116	118	121	124	127	130	134	138	142	146	150	153	157
24	109	111	113	115	117	119	121	124	127	130	134	138	142	146	150	154	158
25	109	111	113	115	117	119	121	124	128	131	135	139	143	147	151	154	158
26	110	112	114	116	118	120	122	125	128	131	135	139	143	147	151	155	159
27	110	112	114	116	118	120	122	125	129	132	136	140	144	148	152	155	159
28	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
29	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
30	112	114	116	118	120	122	124	127	131	134	138	142	146	150	154	157	161
31	113	115	117	119	121	123	125	128	132	135	139	143	147	151	154	157	161
32	113	115	117	119	121	123	125	128	132	136	140	144	148	152	155	158	162
33	114	116	118	120	122	124	126	129	133	137	141	145	149	153	156	159	162
34	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
35	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
36	116	118	120	122	124	126	128	131	135	139	143	147	151	155	158	161	164
37	116	118	120	122	124	126	129	132	136	140	144	148	152	156	159	162	165
38	117	119	121	123	125	127	130	133	137	141	145	149	153	157	160	163	166
39	118	120	122	124	126	128	131	134	138	142	146	150	154	158	161	164	167
40	119	121	123	125	127	129	132	135	138	142	146	150	154	158	161	164	167
41	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	165	168
42	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	166	169
43	121	123	125	127	129	131	134	137	140	144	148	152	156	160	163	167	170
44	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
45	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
46	123	125	127	129	131	133	136	139	142	146	150	154	158	162	165	169	172
47	123	125	127	129	131	133	136	139	142	146	151	155	159	163	166	170	173
48	124	126	128	130	132	134	137	140	143	147	152	156	160	164	167	171	174
49	124	126	128	130	132	134	137	140	143	147	152	156	161	165	168	172	175
50	125	127	129	131	133	135	138	141	144	148	152	156	161	165	169	173	176
51	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
52	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
53	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
54	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177
55	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177

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